DRAWN BY: Author CHECKED BY: Checker

MECHANICAL LEGEND

SYMBOL	DESCRIPTION
PLAN-VIEW LINE TYPES	
	WORK SHOWN FADED INDICATES EXISTING WORK TO REMAIN OR NEW WORK BY OTHERS AS APPLICABLE
	WORK SHOWN BOLD-DASHED INDICATES SELECTIVE DEMOLITION WORK
	WORK SHOWN BOLD-CONTINUOUS INDICATES NEW WORK
DRAWING SET APPEARANCE	
TO BETTER COMMUNICATE SCOPE TO PERMIT AGENCIES AND CONTRACTORS, EACH DRAWING IN THIS DRAWING SET HAS BEEN CREATED IN BOTH "COLOR" AND "BLACK AND WHITE". THERE EXISTS A COLOR LAYER WITHIN EACH DRAWING WHERE VISIBILITY IS CONTROLLED THROUGH THE PDF LAYER MANAGER. THIS LAYER VISIBILITY CAN BE TOGGLED DISPLAYING EITHER "COLOR" OR "BLACK AND WHITE". TO MAINTAIN SCOPE BASED SHADING WHEN PRINTING TO PAPER, BLACK AND WHITE NEEDS TO BE VISIBLE. FOR FURTHER INSTRUCTIONS, REFER TO CONTRACTOR RESOURCES ON OUR WEBSITE AND DOWNLOAD "DRAWING COLOR INSTRUCTIONS". WWW.KLHENGRS.COM - CONTRACTOR RESOURCES (RIGHT HAND SIDE OF PAGE).	
PIPING LINE TYPES	
HPWS	HEAT PUMP WATER SUPPLY
HPWR	HEAT PUMP WATER RETURN
CD	CONDENSATE DRAIN
	SUPPLY MAIN OR BRANCH
	RETURN MAIN OR BRANCH

MECHANICAL LEGEND

SYMBOL	DESCRIPTION
MECHANICAL MISCELLANOUS	
DI	DIGITAL INPUT
DO	DIGITAL OUTPUT
AI	ANALOG INPUT
AO	ANALOG OUTPUT
	CONNECT TO EXISTING (FIELD VERIFY EXISTING UTILITY SERVICE TYPE, PRIOR TO MAKING CONNECTION)
1" UC 0'-1"	1" DOOR UNDERCUT
	POINT OF DEMOLITION TO EXISTING (FIELD VERIFY EXISTING UTILITY SERVICE TYPE, PRIOR TO TERMINATING CONNECTION)
MECHANICAL STATS & SENSORS	
TS	TEMPERATURE SENSOR
T	LOW VOLTAGE THERMOSTAT
T	LOW VOLTAGE THERMOSTAT WITH LOCKABLE GUARD
MECHANICAL DUCTWORK ACCESSORIES	
	ROUND ELBOW WITH TURNING VANES
	DUCT WITH MANUAL VOLUME DAMPER
	ELBOW WITH TURNING VANES
M	MOTOR OPERATED DAMPER - LINE VOLTAGE
M	MOTOR OPERATED DAMPER - LOW VOLTAGE
S	DUCT MOUNTED SMOKE DETECTOR (HARD WIRE INTERLOCK TO FAN MOTOR BY E.C.) FURNISHED BY E.C., INSTALLED BY M.C.
MECHANICAL AIR DEVICES	
SR	SUPPLY REGISTER
RR	RETURN REGISTER
ER	EXHAUST REGISTER
SG	SUPPLY GRILLE
RG	RETURN GRILLE
CD	CEILING DIFFUSER
CD-10"Ø	2'x2' SQUARE CEILING DIFFUSER WITH 10" NECK
MECHANICAL DUCTWORK	
UP	SUPPLY DUCT WITH ELBOW TURNED UP
DN	SUPPLY DUCT WITH ELBOW TURNED DOWN
UP	RETURN DUCT WITH ELBOW TURNED UP
DN	RETURN DUCT WITH ELBOW TURNED DOWN
UP	EXHAUST DUCT WITH ELBOW TURNED UP
DN	EXHAUST DUCT WITH ELBOW TURNED DOWN
24X12 SA	SUPPLY DUCT
24X12 RA	RETURN DUCT
24X12 EA	EXHAUST DUCT
24X12 OA	OUTSIDE AIR DUCT
	1" LINED DUCTWORK
	FLEXIBLE DUCTWORK CONNECTION
	BRANCH TAKEOFF
	REDUCER, CONCENTRIC
	REDUCER, NONCONCENTRIC
	DUCT FLEX CONNECTOR

NEW WORK GENERAL NOTES

A. PROVIDE ALL LABOR, MATERIAL, AND EQUIPMENT NECESSARY TO COMPLETELY FURNISH, INSTALL, AND PLACE INTO OPERATION, ALL SYSTEMS SHOWN ON THE DRAWINGS AND DELINEATED IN THE SPECIFICATIONS IN ACCORDANCE WITH ALL STATE AND LOCAL CODES AND ORDINANCES. REPORT ANY KNOWN DISCREPANCIES TO THE ARCHITECT/ENGINEER PRIOR TO INSTALLATION.

B. REFER TO ARCHITECTURAL REFLECTED CEILING PLANS FOR EXACT LOCATIONS OF CEILING DIFFUSERS, REGISTERS AND GRILLES.

C. DO NOT SCALE DRAWINGS; REFER TO ARCHITECTURAL DRAWINGS FOR DIMENSIONED LOCATIONS OF WALLS, DOORS, WINDOWS, AND CABINETRY.

D. COORDINATE WORK AND SPACE REQUIREMENTS IN CEILING SPACES WITH OTHER TRADES PRIOR TO INSTALLATION.

E. COORDINATE LOCATIONS AND ORIENTATION OF ROOF MOUNTED EQUIPMENT WITH ARCHITECTURAL AND STRUCTURAL DRAWINGS.

F. COORDINATE WALL LOUVERS WITH ARCHITECTURAL ELEVATIONS AND DETAILS.

G. PROVIDE VOLUME DAMPERS AT ALL SUPPLY, RETURN, AND EXHAUST DUCT BRANCH TAKE-OFFS.

H. PROVIDE TURNING VANES IN ALL 90 DEGREE MITERED ELBOWS. OMIT TURNING VANES IN ACOUSTIC LINED RETURN DUCT ELBOWS.

I. PROVIDE FLEXIBLE DUCT ON INLET TO EACH CEILING DIFFUSER. CUT FLEXIBLE DUCTS TO LENGTH NEEDED AND INSTALL WITHOUT KINKS OR SHARP BENDS (BENDS WITH CENTERLINE RADIUS LESS THAN DUCT DIAMETER). SUPPORT FLEXIBLE DUCTS WITH MINIMUM 1" WIDE METAL STRAPS OR SADDLES.

J. SIZES OF ACOUSTIC LINED DUCTS ARE NET INSIDE DIMENSION. INCREASE SHEET METAL SIZE ACCORDINGLY.

K. RUNOUTS TO CEILING DIFFUSERS ARE THE SAME SIZE AS THE DIFFUSER NECK UNLESS NOTED OTHERWISE.

L. INSTALL ALL EQUIPMENT WITH CODE REQUIRED AND MANUFACTURER RECOMMENDED MINIMUM CLEARANCES FOR SERVICE, ACCESS, AND FIRE PROTECTION.

M. MAINTAIN A MINIMUM OF 10 FEET BETWEEN ALL OUTSIDE AIR INTAKES AND ALL EXHAUST, VENT, AND FLUE OUTLETS.

N. ALL MATERIALS EXPOSED WITHIN PLENUMS SHALL BE NON-COMBUSTIBLE OR SHALL HAVE A FLAME SPREAD INDEX OF NOT MORE THAN 25 AND A SMOKE-DEVELOPED INDEX OF NOT MORE THAN 50 WHEN TESTED IN ACCORDANCE WITH ASTME E 84.

O. ALL FLOOR PENETRATIONS SHALL BE COORDINATED WITH THE CONCRETE RIBS IN THE FLOOR STRUCTURE.

STANDARD HVAC ABBREVIATIONS

AAV	AUTOMATIC AIR VENT	HD	HEAD	RQ	REVERSE OSMOSIS
ACCESS	ACCESSORIES	HOA	HAND/OFF/AUTOMATIC	RPM	REVOLUTIONS PER MINUTE
AD	ACCESS DOOR	HP	HORSEPOWER	RS	REFRIGERANT SUCTION
AFF	ABOVE FINISHED FLOOR	HPR	HIGH PRESSURE RETURN (STEAM CONDENSATE)	SA	SUPPLY AIR
AMP	AMPERE			SAT	SUPPLY AIR TEMPERATURE
AP	ACCESS PANEL	HSTAT	HUMIDISTAT	SC	SHADING COEFFICIENT
APD	AIR PRESSURE DROP	HTG	HEATING	SCD	SMOKE CONTROL DAMPER
ARI	AIR CONDITIONING AND REFRIGERATION INSTITUTE	HWR	HEATING HOT WATER RETURN	SD	SMOKE DETECTOR
ASME	AMERICAN SOCIETY OF MECHANICAL ENGINEERS	HWS	HEATING HOT WATER SUPPLY	SENS	SENSIBLE HEAT
BAS	BUILDING AUTOMATION SYSTEM	HZ	HERTZ	SP	STATIC PRESSURE
BD	BACKDRAFT DAMPER	I/O	INPUT/OUTPUT	TAB	TESTING, ADJUSTING, BALANCE
BHP	BRAKE HORSEPOWER	IAQ	INDOOR AIR QUALITY	TDH	TOTAL DYNAMIC HEAD
BTU	BRITISH THERMAL UNIT	IN HG	INCHES OF MERCURY	TDS	TOTAL DISSOLVED SOLIDS
BTUH	BRITISH THERMAL UNIT PER HOUR	IN WC	INCH WATER COLUMN	TSP	TOTAL STATIC PRESSURE
CD	CEILING DIFFUSER	IN WG	INCH WATER GAUGE	TSTAT	THERMOSTAT
CFH	CUBIC FEET PER HOUR	IPLV	INTERGRATED PART LOAD VALUE	UL	UNDERWRITERS LABORATORY
CFM	CUBIC FEET PER MINUTE	INST	INSTALLED	VAV	VARIABLE AIR VOLUME
CHWR	CHILLED WATER RETURN	KW	KILOWATT	VFD	VARIABLE FREQUENCY DRIVE
CHWS	CHILLED WATER SUPPLY	KWH	KILOWATT HOUR	WB	WET-BULB (TEMPERATURE)
CI	CAST IRON	LAT	LEAVING AIR TEMPERATURE	WG	WATER GAGE
CLG	COOLING	LBS/HR	POUNDS PER HOUR	WPD	WATER SIDE PRESSURE DROP
CO	CARBON MONOXIDE	LF	LINEAR FOOT (FEET)	WIRE	WIRED
CO2	CARBON DIOXIDE	LPR	LOW PRESSURE RETURN (STEAM CONDENSATE)		
COP	COEFFICIENT OF PERFORMANCE				
CV	CONSTANT VOLUME	LPS	LOW PRESSURE STEAM		
CWR	CONDENSER WATER RETURN	LWT	LEAVING WATER TEMPERATURE		
CWS	CONDENSER WATER SUPPLY	MAX	MAXIMUM		
DB	DECIBELS	MBH	1000 BTUH		
DB	DRY-BULB TEMPERATURE	MCA	MINIMUM BRANCH CIRCUIT AMPACITY		
DC	DISCONNECT	MERV	MINIMUM EFFICIENCY REPORTING VALUE		
DDC	DIRECT DIGITAL CONTROLS	MIN	MINIMUM		
DEG	DEGREE DELTA(CHANGE IN TEMPERATURE)	MOD	MOTOR OPERATED DAMPER		
DIA	DIAMETER	MPR	MEDIUM PRESSURE RETURN (STEAM CONDENSATE)		
DIW	DEIONIZED WATER				
DP	DEW POINT TEMPERATURE	MPS	MEDIUM PRESSURE STEAM		
DX	DIRECT EXPANSION	MRI	MAGNETIC RESONANCE IMAGING		
EA	EXHAUST AIR	MVD	MANUAL VOLUME DAMPER		
EAT	ENTERING AIR TEMPERATURE	NA	NOT APPLICABLE		
EER	ENERGY EFFICIENCY RATIO	NC	NOISE CRITERIA		
EG	EXHAUST GRILLE	NC	NORMALLY CLOSED		
EMERG	EMERGENCY POWER	NO	NORMALLY OPEN		
ESP	EXTERNAL STATIC PRESSURE	NTS	NOT TO SCALE		
EWT	ENTERING WATER TEMPERATURE	OA	OUTSIDE AIR		
EX	EXISTING	OCP	OVER CURRENT PROTECTION		
F	FAHRENHEIT	PD	PRESSURE DROP		
F&T	FLOAT AND THERMOSTATIC	PPM	PARTS PER MILLION		
FA	FREE AREA	PRS	PRESSURE REGULATING (VALVE) STATION		
FD	FIRE DAMPER	PRV	PRESSURE REGULATING VALVE		
FLA	FULL LOAD AMPERES	PSI	POUNDS PER SQUARE INCH		
FPM	FEET PER MINUTE	PSIA	POUNDS PER SQUARE INCH – ABSOLUTE		
FPS	FEET PER SECOND	PSIG	POUNDS PER SQUARE INCH – GAGE		
FT	FEET	RA	RETURN AIR		
FURN	FURNISHED	RAT	RETURN AIR TEMPERATURE		
GA	GAUGE	RH	RELATIVE HUMIDITY		
GAL	GALLONS	RL	REFRIGERANT LIQUID LINE		
GPM	GALLONS PER MINUTE	RLA	RUN LOAD AMPERE		

DRAWING INDEX - MECHANICAL

ARCX STUDIO

ARCHITECT & INTERIOR DESIGN

ARCX STUDIO

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1616 VINE STREET, CINCINNATI, OH 45202
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KLH ENGINEERS

ENGINEER

KOHRS LONNEMANN HEIL ENGINEERS, INC.

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B200 MICROBIOLOGY RENOVATION LEVEL 03

5365 MEDPACE WAY
CINCINNATI OH 45227

ARCX STUDIO PROJECT NUMBER

2325

OWNER

STATE OF OHIO
KRIS T. SCHNITGEN
E-77432
REGISTERED
PROFESSIONAL ENGINEER
1/19/2024

REVISION

Δ	DESCRIPTION	DATE

ISSUED FOR

BID & PERMIT
01-19-2024

SHEET NAME

MECHANICAL COVER SHEET

SHEET NO.

M0.71

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1/19/2024 5:29:35 PM C:\Users\chief\Documents\Revit\2040\20-22-MEP-Medpace B200 - Level 3 Microbiology Lab_cchief.rvt

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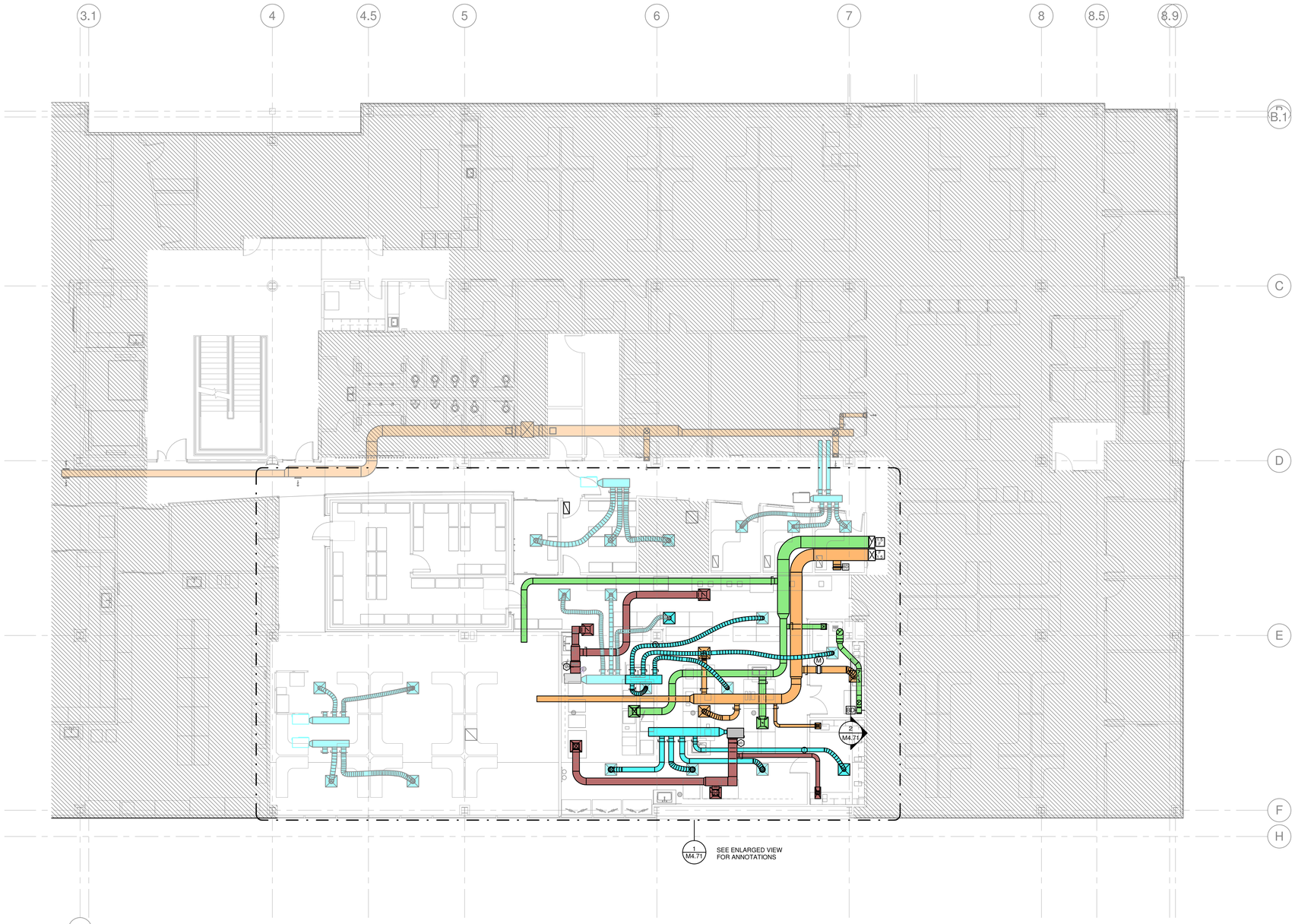
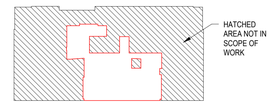


1 MECHANICAL NEW DUCTWORK PLAN - LVL 03
1/8" = 1'-0"



THIRD FLOOR

Keyplan
1" = 40'-0"

THIS SHEET WHEN PLOTTED AT FULL SIZE MEASURES 30" X 42"

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1/19/2024

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MECHANICAL NEW DUCTWORK PLAN - LVL 03

SHEET NO.

M2.73

1/19/2024 5:29:03 PM C:\Users\chad\Documents\Revit\2640.05-23-MEP-Medpace B200 - Level 3 Microbiology Lab_cshaw.rvt

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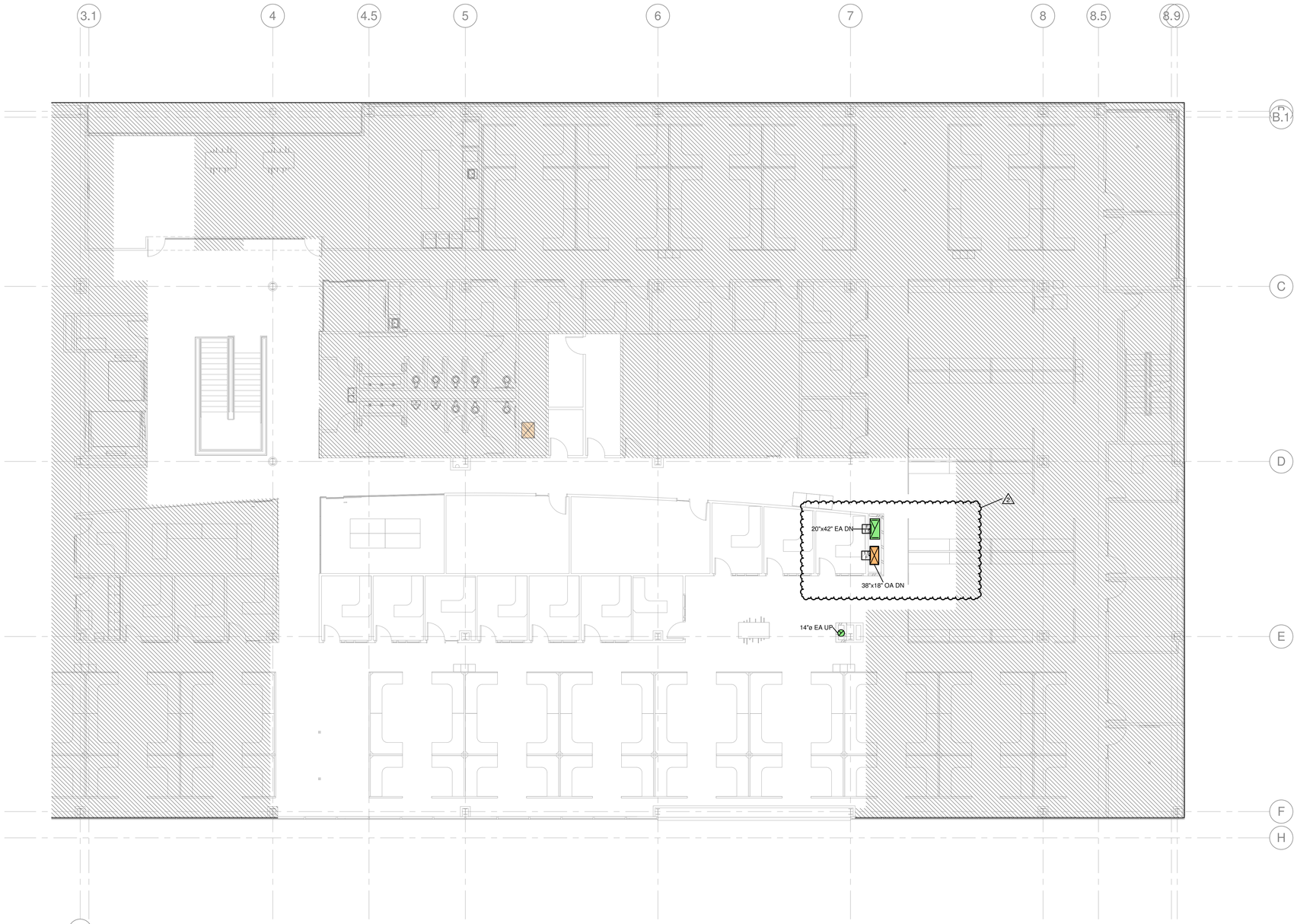

1 MECHANICAL NEW DUCTWORK PLAN - LVL 04
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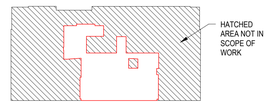

THIRD FLOOR

Keyplan
1" = 40'-0"

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4/24/2024 2:45:39 PM 20040.00-23-MEP-Medpace B200 - Level 3 Microbiology Lab _detached.rvt

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REVISION

△	DESCRIPTION	DATE
1	Revision 1	02.23.24
2	BULLETIN 04	04.24.24

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MECHANICAL NEW DUCTWORK PLAN - LVL 04

SHEET NO.

M2.74

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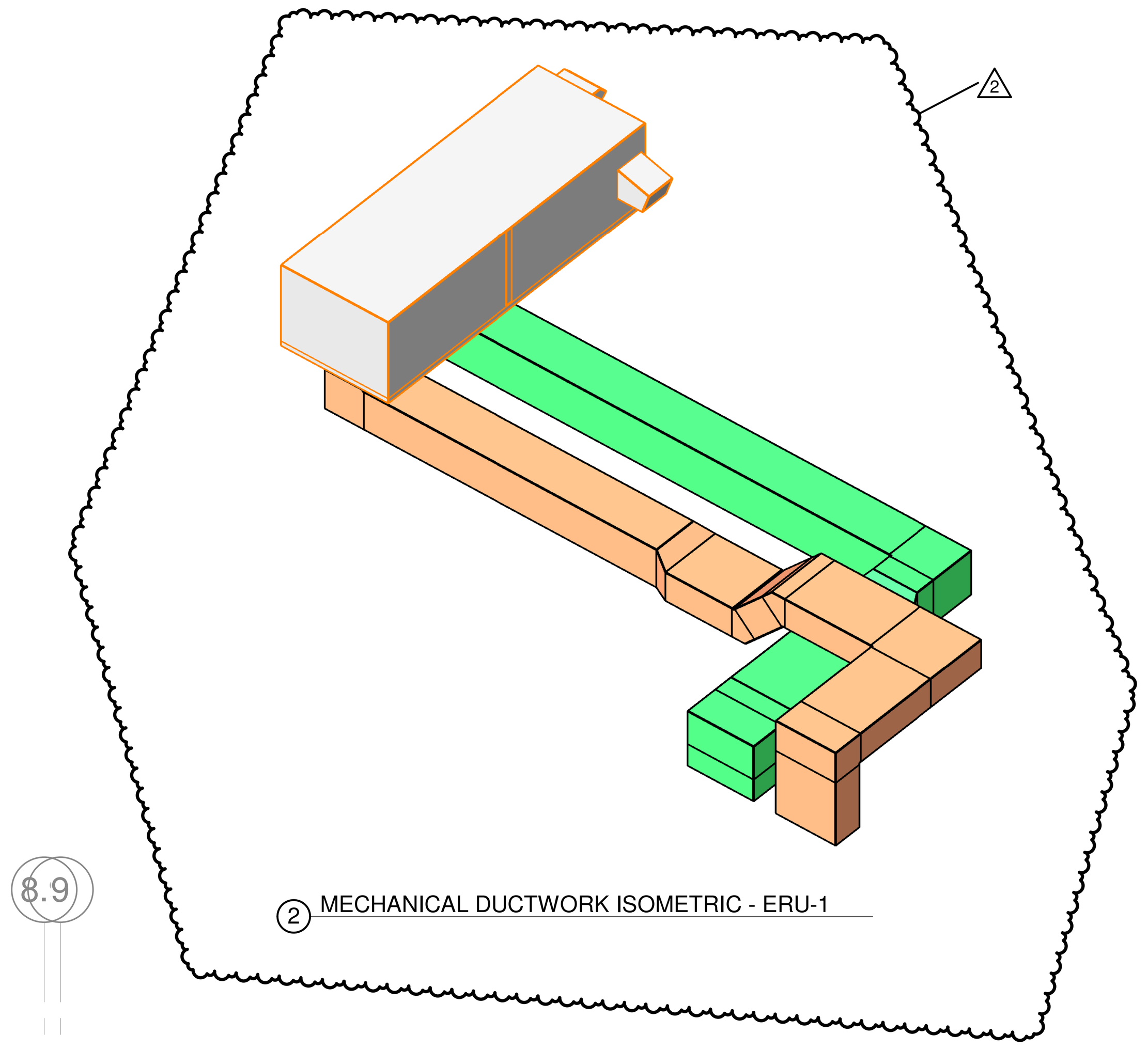
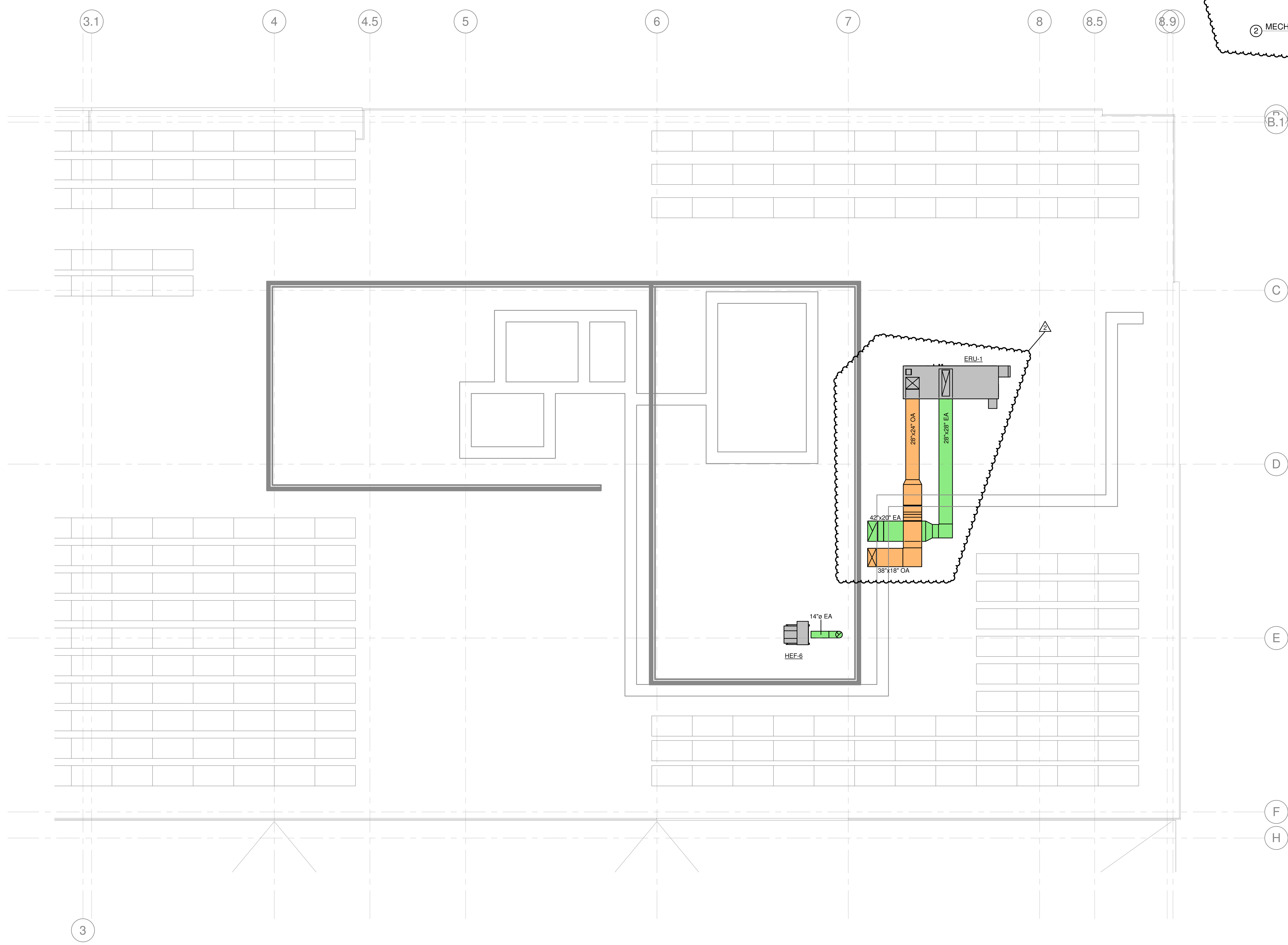
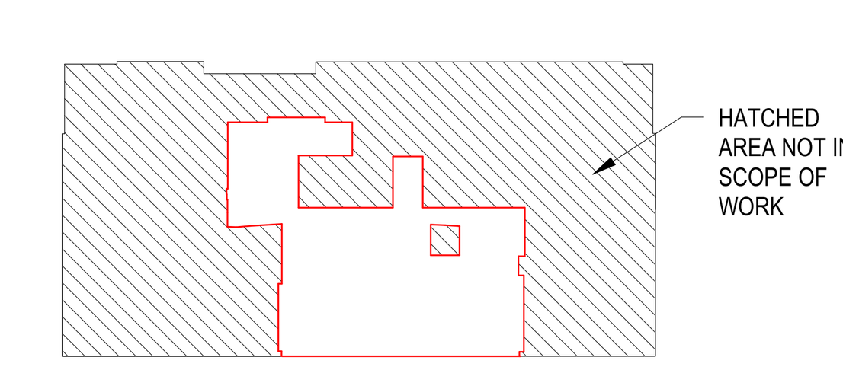




1 MECHANICAL NEW DUCTWORK PLAN - ROOF
1/8" = 1'-0"



Keyplan
1" = 40'-0"

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ARCHITECT & INTERIOR DESIGN

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REVISION

△	DESCRIPTION	DATE
1	Revision 1	02.23.24
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MECHANICAL NEW DUCTWORK PLAN - ROOF

M2.75

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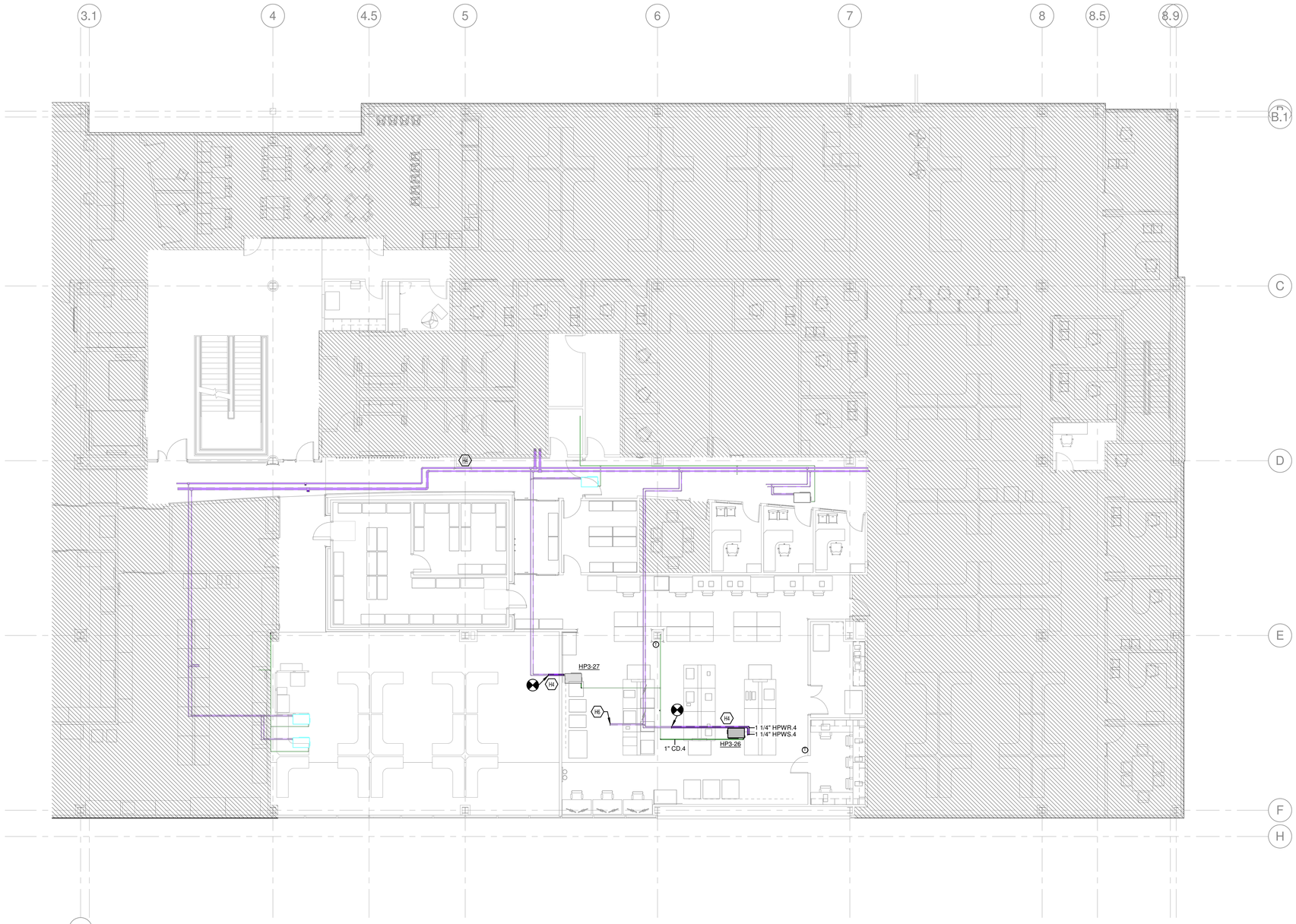
Pipe Type Legend			
Mark	Color	System Name	Pipe Material
CD.4		CD - Condensate	4 - Copper - Type K - ASTM B88
HPWR.4		HPWR - Heat Pump Water Return	4 - Copper - Type K - ASTM B88
HPWS.4		HPWS - Heat Pump Water Supply	4 - Copper - Type K - ASTM B88

KEYED NOTES

H4	EXTEND EXISTING HEAT PUMP WATER PIPING TO UNIT IN IT'S NEW LOCATION. CONNECT WITH FLEX HOSE.
H6	CAP EXISTING HEAT PUMP WATER PIPING.



1 MECHANICAL NEW DUCTWORK PLAN - LVL 03
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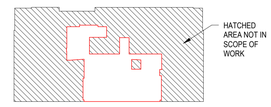

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MECHANICAL NEW PIPING PLAN - LVL 03

SHEET NO.

M3.73

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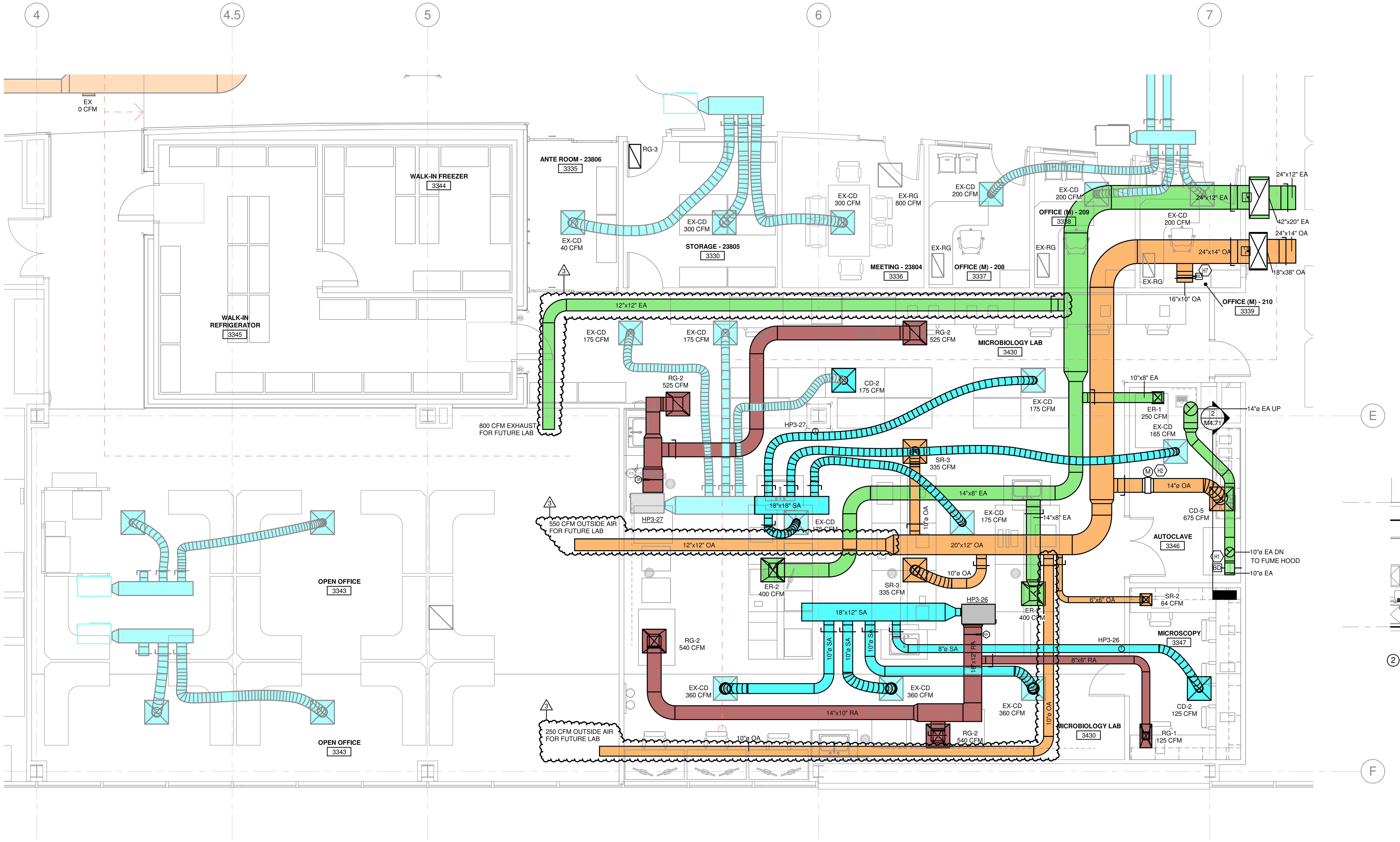
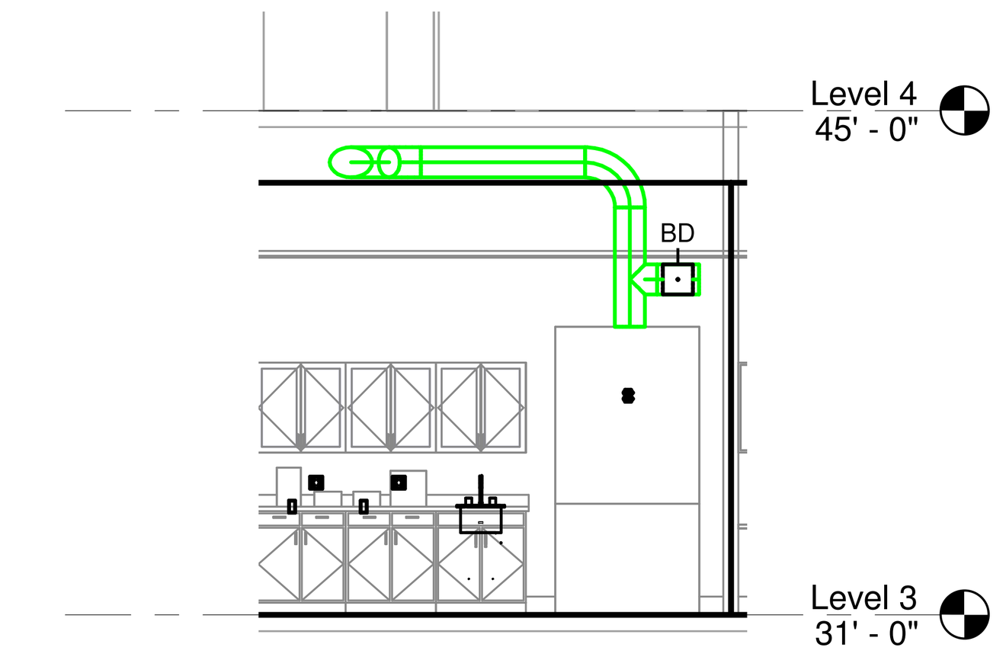
KEYED NOTES	
H1	COUNTER-BALANCE BAROMETRIC DAMPER IN BRANCH OFF OF EXHAUST DUCT TO OPEN AS HOOD DOOR CLOSES TO ACHIEVE CONSTANT AIRFLOW RATE OF 725 CFM.
H2	2-POSITION MOTOR OPERATED DAMPER IN OUTSIDE AIR DUCT SERVING AUTOCLAVE ROOM. WHEN EXHAUST HOOD IS ENERGIZED, DAMPER SHALL BE OPEN TO PROVIDE 675 CFM OF MAKEUP AIR. WHEN HOOD IS OFF, DAMPER TO BE CLOSED.
H7	COUNTER-BALANCE BAROMETRIC IN OUTSIDE AIR DUCT IN PLENUM TO OPEN AS TWO-POSITION MOTOR OPERATED DAMPER SERVING AUTOCLAVE ROOM CLOSES.



1 MICROBIOLOGY ENLARGED VIEW
1/4" = 1'-0"



2 HOOD EXHAUST ELEVATION
3/16" = 1'-0"

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REVISION

△	DESCRIPTION	DATE
1	REVISION 1	02.23.24
2	BULLETIN 04	04.24.24
3	BULLETIN 06	05.21.24

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01-17-2024

SHEET NAME
MECHANICAL ENLARGED PLANS

SHEET NO.
M4.71

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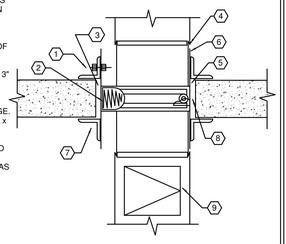
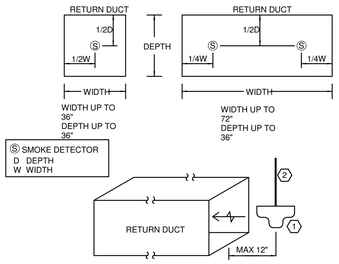
KEYED NOTES:

1. RETAINING ANGLES ATTACHED TO SLEEVES WITH 1/4" BOLTS OR 1/2" WELDS 6" O.C. BEGIN 2" FROM CORNERS
2. FIRE DAMPER BLADES
3. CLEARANCE FOR THERMAL EXPANSION 1/8" PER FOOT OF DUCT DIMENSION. MAX 1/2" - HALF FOR EACH SIDE
4. SLEEVE TO EXTEND MIN. OF 3" BEYOND FLOOR LINE
5. BOLT OR WELD DAMPER TO SLEEVE (TYP).
6. STEEL SLEEVE MIN. 14 GAUGE.
7. RETAINING ANGLES MIN 1-1/2" x 1-1/2" 12 GA. FOR DUCTS UP TO 48"
8. INTERIOR OF OPENING LINED W/ U.L. LISTED MATERIAL HAVING SAME FIRE RATING AS FLOOR.
9. ACCESS DOOR



233313.00-15 - FIRE DAMPER FLOOR PENETRATION

SCALE: NONE

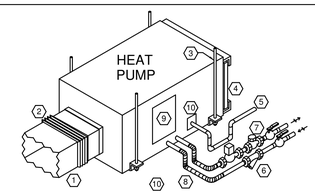


KEYED NOTES:

1. SMOKE DETECTOR FURNISHED AND WIRED BY E.C. INSTALL DETECTOR WITHIN 12" OF THE OPENING OF RETURN DUCT. INSTALL DETECTOR IN ACCORDANCE WITH OPENING DIMENSIONS SHOWN ABOVE. PROVIDE AN ADDITIONAL DETECTOR AS REQUIRED.
2. MOUNT DETECTOR FROM THREADED ROD SUSPENDED FROM STRUCTURE. PROVIDE HORIZONTAL BRACING FOR THREADED ROD AS REQUIRED TO PREVENT SWAYING.

238146.00-07 - SMOKE DETECTOR DETAIL

SCALE: NONE

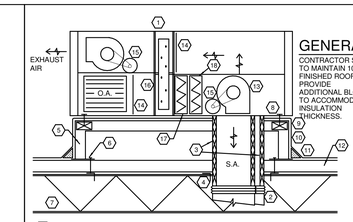


KEYED NOTES:

1. SUPPLY DUCT - 1/2" INTERNAL INSULATION
2. FLEXIBLE CONNECTION
3. GALVANIZED ALL-THREAD ROD WITH VIBRATION ISOLATOR (TYPICAL)
4. FILTER AND RACK.
5. CONDENSATE LINE WITH TRAP
6. SHUTOFF VALVE, UNIONS, AND STRAINER (SUPPLY SIDE)
7. AUTOMATIC BALANCING VALVE, FULL PORT, 2 POSITION, 2-WAY CONTROL VALVE, UNIONS, AND SHUTOFF VALVE (RETURN SIDE) WITH PRESSURE TEST PORTS
8. FLEXIBLE HOSE KITS
9. SERVICE ACCESS PANEL
10. HIGH CONDENSATE LEVEL SWITCH.

238146.00-06 - WATER SOURCE HEAT PUMP

SCALE: NONE



GENERAL NOTES:

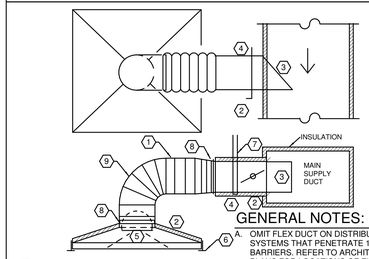
CONTRACTOR SHALL PROVIDE CURB TO MAINTAIN 10" MINIMUM ABOVE FINISHED ROOFING SYSTEM. PROVIDE ADDITIONAL BLOCKING AS REQUIRED TO ACCOMMODATE ROOF INSULATION THICKNESS.

KEYED NOTES:

1. ROOFTOP HEAT RECOVERY UNIT LOCATE A MINIMUM OF 10'-0" FROM EDGE OF ROOF AND ROOF HATCH.
2. CANVAS FLEXIBLE CONNECTION.
3. 1" ACOUTSIC LINED DUCTS
4. 4x4 ANGLE FASTENED TO ROOF DECK AND STRUCTURAL SYSTEM. PROVIDE SUPPORTS AS REQUIRED.
5. FACTORY FABRICATED CURB (BY SAME MANUFACTURER AS UNIT).
6. FASTEN CURB TO DECK
7. BUILDING ROOF STRUCTURE
8. SECURE TO CURB
9. WOOD NAILER
10. CURB TYPE AND FLASHING PER ROOFING MANUFACTURER'S REQUIREMENTS. FLASH UP AND UNDER UNIT
11. CANT STRIP
12. ROOF DECK
13. FAN HOUSING
14. 2" - 30% FILTER FOR AIR ENTERING WHEEL
15. BELT DRIVE FAN MOTOR
16. HEAT RECOVERY WHEEL
17. CHILLED WATER COIL
18. HOT WATER COIL

237213.00-01 - HRU ROOF CURB & MOUNTING

SCALE: NONE



GENERAL NOTES:

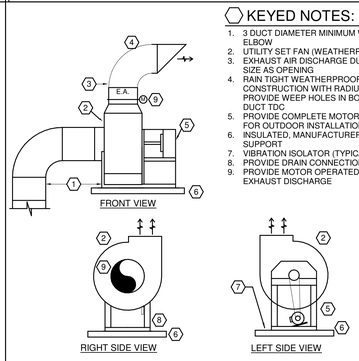
A. OMIT FLEX DUCT ON DISTRIBUTION SYSTEMS THAT PENETRATE 1-HR FIRE BARRIERS. REFER TO ARCHITECTURAL PLANS FOR LOCATIONS OF FIRE BARRIERS.

KEYED NOTES:

1. MAXIMUM LENGTH OF INSUL. FLEX DUCT EQUALS 5 FEET. FLEX NOT PERMITTED IN INACCESSIBLE CEILINGS
2. INSULATED DUCT, COLLAR AND DIFFUSER BY HVAC CONTRACTOR
3. SCOOP
4. SPIN IN FITTING WITH MANUAL VOLUME DAMPER
5. INTERNAL BUTTERFLY DAMPER FOR DRYWALL APPLICATIONS ONLY. (PROVIDE KEY FOR ADJUSTMENT)
6. SECURE TO CEILING PER MANUFACTURER'S RECOMMENDATIONS AND PER CEILING FINISH. PROVIDE GRID CLIPS PER MFG'R REQUIREMENTS. PROVIDE FRAMING FOR DRYWALL INSTALLATION.
7. HANGER, SECURE TO STRUCTURE AND DUCTWORK
8. PEEL BACK INSULATION AND PROVIDE STRAPPING AND SHEET METAL SCREWS AT FLEX CONNECTION TO DUCT. THEN PROVIDE STRAPPING AROUND INSULATION
9. SUPPORT FLEX TO PREVENT COLLAPSING

233713.00-04 - DIFFUSER INSTALLATION TYPICAL

SCALE: NONE



KEYED NOTES:

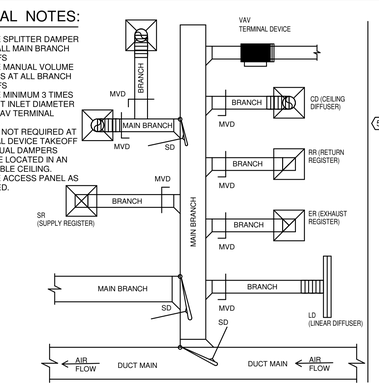
1. 3 DUCT DIAMETER MINIMUM WITH RADIUS ELBOW
2. UTILITY SET FAN (WEATHERPROOF HOUSING)
3. EXHAUST AIR DISCHARGE DUCTWORK SAME SIZE AS OPENING
4. RAIN TIGHT WEATHERPROOFED DUCTWORK CONSTRUCTION WITH RADIUS ELBOWS, PROVIDE WEEP HOLES IN BOTTOM, MAKE DUCT TOC
5. PROVIDE COMPLETE MOTOR ENCLOSURE FOR OUTDOOR INSTALLATION
6. INSULATED, MANUFACTURER'S ROOF CURB & SUPPORT
7. VIBRATION ISOLATOR (TYPICAL)
8. PROVIDE DRAIN CONNECTION W/ PLUG
9. PROVIDE MOTOR OPERATED DAMPER AT EXHAUST DISCHARGE

233400.00-03 - UTILITY SET EXHAUST FAN

SCALE: NONE

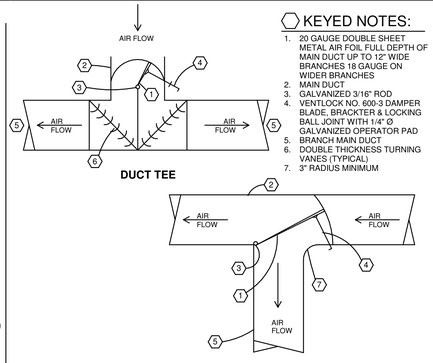
GENERAL NOTES:

1. PROVIDE SPLITTER DAMPER (SD) AT ALL MAIN BRANCH TAKEOFFS
2. PROVIDE MANUAL VOLUME DAMDERS AT ALL BRANCH TAKEOFFS
3. PROVIDE MINIMUM 3 TIMES STRAIGHT INLET DIAMETER TO ALL VAV TERMINAL DEVICES
4. DAMPER NOT REQUIRED AT TERMINAL DEVICE TAKEOFF
5. ALL MANUAL DAMPERS SHALL BE LOCATED IN AN ACCESSIBLE CEILING. PROVIDE ACCESS PANEL AS REQUIRED.



233300.00-01 - MANUAL DAMPER DETAIL

SCALE: NONE

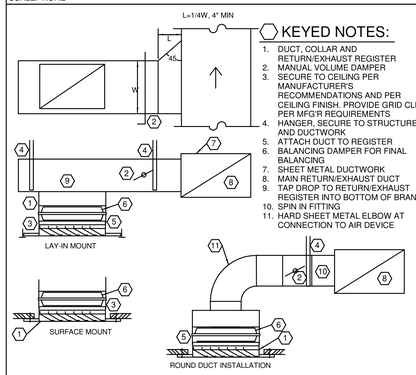


KEYED NOTES:

1. 20 GAUGE DOUBLE SHEET METAL AIR FOIL FULL DEPTH OF MAIN DUCT UP TO 12" WIDE BRANCHES 18 GAUGE ON WIDER BRANCHES
2. MAIN DUCT
3. GALVANIZED 3/16" ROD
4. VENTLOCK NO. 600-3 DAMPER BLADE, BRACKTER & LOCKING BALL JOINT WITH 1/4" Ø GALVANIZED OPERATOR PAD
5. BRANCH MAIN DUCT
6. DOUBLE THICKNESS TURNING VANES (TYPICAL)
7. 3" RADIUS MINIMUM

233300.00-01 - MANUAL DAMPER DETAIL

SCALE: NONE

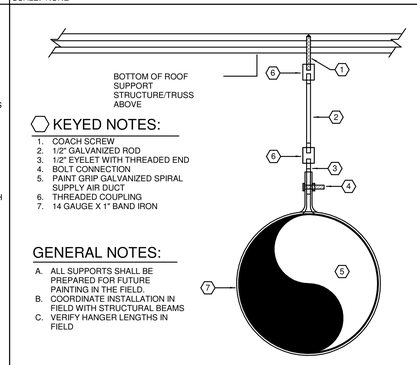


KEYED NOTES:

1. DUCT, COLLAR AND RETURN/EXHAUST REGISTER
2. MANUAL VOLUME DAMPER
3. SECURE TO CEILING PER MANUFACTURER'S RECOMMENDATIONS AND PER CEILING FINISH. PROVIDE GRID CLIPS PER MFG'R REQUIREMENTS
4. HANGER, SECURE TO STRUCTURE AND DUCTWORK
5. ATTACH DUCT TO REGISTER
6. BALANCING DAMPER FOR FINAL BALANCING
7. SHEET METAL DUCTWORK
8. MAIN RETURN/EXHAUST DUCT
9. TAP DROP TO RETURN/EXHAUST REGISTER INTO BOTTOM OF BRANCH
10. SPIN IN FITTING
11. HARD SHEET METAL ELBOW AT CONNECTION TO AIR DEVICE

233713.00-21 - RETURN/EXHAUST REGISTER INSTALLATION

SCALE: NONE



KEYED NOTES:

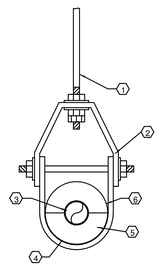
1. COACH SCREW
2. 1/2" GALVANIZED ROD
3. 1/2" EYELET WITH THREADED END
4. BOLT CONNECTION
5. PAINT GRIP GALVANIZED SPIRAL SUPPLY AIR DUCT
6. THREADED COUPLING
7. 14 GAUGE X 1" BAND IRON

GENERAL NOTES:

A. ALL SUPPORTS SHALL BE PREPARED FOR FUTURE PAINTING IN THE FIELD.
B. COORDINATE INSTALLATION IN FIELD WITH STRUCTURAL BEAMS
C. VERIFY HANGER LENGTHS IN FIELD

233113.00-03 - DUCT SUPPORT DETAIL B

SCALE: NONE



KEYED NOTES:

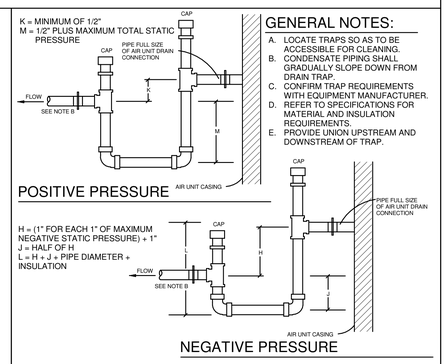
1. HANGER ROD TO STRUCTURE.
2. INSULATION OD MUST BE LESS THAN U-STRAP ID.
3. PIPE CARRYING LOW TEMPERATURE FLUID.
4. INSULATION PROTECTIVE SADDLE AND CALCIUM SILICATE INSERT FOR GLASS FIBER PIPE INSULATION OR INSULATION PROTECTION SHIELD FOR CELLULAR GLASS PIPE INSULATION.
5. PIPEINSULATION. SEAL ALL JOINTS AND SEAMS WITH INSULATION MANUFACTURER RECOMMENDED ADHESIVE APPLIED AT 100% COVERAGE. FIRMLY BUTT PIPE SECTIONS TOGETHER AFTER APPLY ADHESIVE TO MATING SURFACES AND WRAP PIPE WITH TAPE OR STRAPS WITH OVERLAPPING ENDS TO FIRMLY HOLD INSULATION TOGETHER.
6. CONTINUOUS VAPOR BARRIER JACKET ON OUTER SURFACE OF INSULATION. SEAL ALL JOINTS AND SEAMS OF VAPOR BARRIER WITH MANUFACTURER RECOMMENDED TAPE OR MASTIC.

GENERAL NOTES:

A. IMPERATIVE THAT INSULATION DOES NOT HAVE GAPS OR CRACKS THAT ALLOW AMBIENT AIR TO REACH PIPE SURFACE.
B. IMPERATIVE THAT VAPOR BARRIER IS CONTINUOUS AND UNBROKEN. ALL DAMAGED VAPOR BARRIER

232113.23-13 - PIPE HANGER AND PIPE INSULATION

SCALE: NONE



GENERAL NOTES:

A. LOCATE TRAPS SO AS TO BE ACCESSIBLE FOR CLEANING.
B. CONDENSATE PIPING SHALL GRADUALLY SLOPE DOWN FROM DRAIN TRAP.
C. CONFIRM TRAP REQUIREMENTS WITH EQUIPMENT MANUFACTURER.
D. REFER TO SPECIFICATIONS FOR MATERIAL AND INSULATION REQUIREMENTS.
E. PROVIDE UNION UPSTREAM AND DOWNSTREAM OF TRAP.

NOTE: OUTDOOR UNITS AND UNITS LOCATED IN UNCONDITIONED SPACES WHICH PROVIDE COOLING IN THE WINTER MUST HAVE HEAT TRACE ON THE CONDENSATE PIPING.

232113.23-05 - CONDENSATE DRAIN TRAP POSITIVE & NEGATIVE

SCALE: NONE

THIS SHEET WHEN PLOTTED AT FULL SIZE MEASURES 30" X 42"

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ARCX STUDIO

ARCHITECT & INTERIOR DESIGN

ARCX STUDIO

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KLH ENGINEERS

ENGINEER

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ARCX STUDIO PROJECT NUMBER

2325

OWNER

STATE OF OHIO
KRIS T. SCHNITGEN
E-77432
REGISTERED
PROFESSIONAL ENGINEER
1/19/2024

REVISION

Δ	DESCRIPTION	DATE

ISSUED FOR

BID & PERMIT
01-19-2024

SHEET NAME

MECHANICAL - DETAILS

SHEET NO.

M5.71

DRAWN BY: Author CHECKED BY: Checker

HVAC ELECTRICAL COORDINATION SCHEDULE

ABBREVIATIONS		CONTRACTOR TYPE		MOTOR CONTROL TYPE		CONTROL TYPE		SHORT CIRCUIT RATING
DC	LOCAL DISCONNECT	EC	ELECTRICAL CONTRACTOR	CS	COMBINATION STARTER	TC	TIMECLOCK	WHERE SHORT CIRCUIT RATING CODE REQUIRED VALUE INDICATES "YES" APPLICABLE EQUIPMENT'S SHORT CIRCUIT RATING SHALL EXCEED THE AVAILABLE FAULT CURRENT VALUE INDICATED.
MC	MOTOR CONTROL (POWER)	EX	EXISTING	MCC	MOTOR CONTROL STARTER	CPT	CONTROL POWER TRANSFORMER	
SD	DUCT SMOKE DETECTOR	FC	FIRE PROTECTION CONTRACTOR	MG	MAGNETIC STARTER OR CONTACT	BAS	BUILDING AUTOMATION SYSTEM	
CN	CONTROLS	GC	GENERAL CONTRACTOR	MS	MANUAL STARTER	LOW	LOW VOLTAGE CONTROLS	
TS	TOGGLE SWITCH	HC	HVAC CONTRACTOR	VFD	VARIABLE FREQUENCY DRIVE	LINE	LINE VOLTAGE CONTROLS	
CB	H.A.C.R. CIRCUIT BREAKER AT SOURCE PANELBOARD	MFR	MANUFACTURER	MSR	MANUAL STARTER W/ CONTROL RELAY	RLINE	REVERSE ACTING LINE VOLTAGE THERMOSTAT	
FUSE	FUSE AT LOCAL DISCONNECT (VERIFY FIELD RATING)	PC	PLUMBING CONTRACTOR	OV	OVERCURRENT PROTECTION	MAN	MANUAL	
FLA	OPERATING FULL LOAD AMPS	OR	OWNER OR OTHERS			FA	FIRE ALARM	
MCA	MINIMUM CIRCUIT AMPACITY					CO	CARBON MONOXIDE SENSOR	
CP	CORD AND PLUG CONNECTION					INT	INTEGRAL TO EQUIPMENT	
[BLANK]	HARD WIRED (WHEN INDICATED FOR DC TYPE)					ASD	AREA SMOKE DETECTOR	
						DSD	DUCT SMOKE DETECTOR	

CONNECTION MARK	DESCRIPTION	VOLTAGE	PHASE	EMERGENCY	HP	WATTS	HTG KW	FLA	MCA	OCP	FED FROM	DC TYPE	DC FURN	DC INST	DC WIRE	MC TYPE	MC FURN	MC INST	MC WIRE	CN TYPE	CN FURN	CN INST	CN WIRE	SHORT CIRCUIT RATING CODE REQUIRED?	AVAILABLE FAULT CURRENT
ERU-1	AIR SOURCE HEAT PUMP ENERGY RECOVERY UNIT	480 V	3	NO					177.8	200			EC	EC	EC	MG	MFR	MFR	MFR	BAS	HC	HC	HC	Yes	22938
HEF-6	HVAC FAN	480 V	3	NO	0.75								EC	EC	EC	MG				MAN	EC	EC	EC	No	1843
HP3-26	WATER SOURCE HEAT PUMP	480 V	3	NO					8.95			EX	--	--	--	EX	--	--	--	EX	--	--	EX	Yes	
HP3-27	WATER SOURCE HEAT PUMP	480 V	3	NO					8.95			EX	--	--	--	EX	--	--	--	EX	--	--	EX	Yes	

HVAC WATER SOURCE HEAT PUMPS SCHEDULES

Equipment shall be braced and labeled by the equipment manufacturer to withstand the minimum scheduled available fault current value for listed equipment.

EQUIPMENT MARK	DESCRIPTION	STATUS	WEIGHT (lbs)	MANUFACTURER	MODEL	CFM (cfm)	ESP (in WC)	NOMINAL TONS	ECWT CLG (Deg F)	LCWT CLG (Deg F)	ECWT HTG (Deg F)	LCWT HTG (Deg F)	COND GPM	MAT CLG DB (Deg F)	MAT CLG WB (Deg F)	CLG MBH	CLG SENS (mbh)	LAT CLG DB (Deg F)	LAT CLG WB (Deg F)	MAT HTG (Deg F)	HTG MBH	LAT HTG (Deg F)	EMERGENCY	ELECTRIC CONNECTION SUMMARY	AVAILABLE FAULT CURRENT
HP3-26	WATER SOURCE HEAT PUMP	EXISTING	0	TRANE	GEHE0364	1200	0	3	86	95	70	60	9	76	64	32	25	55	54	70	0	90	NO	HP3-26 - 480V/3PH, 8.95 MCA	
HP3-27	WATER SOURCE HEAT PUMP	EXISTING	0	TRANE	GEHE0364	1215	0	3	86	95	70	60	9	76	64	32	25	55	54	70	0	90	NO	HP3-27 - 480V/3PH, 8.95 MCA	

HVAC ENERGY RECOVERY UNITS SCHEDULE

Equipment shall be braced and labeled by the equipment manufacturer to withstand the minimum scheduled available fault current value for listed equipment.

EQUIPMENT MARK	DESCRIPTION	STATUS	WEIGHT (lbs)	MANUFACTURER	MODEL	OACFM (cfm)	OA ESP (in WC)	OA BHP (hp)	OA HP (hp)	OA FAN RPM	EA CFM	EA ESP (in WC)	EA BHP (hp)	EA HP (hp)	EA FAN RPM	EMERGENCY	ELECTRIC CONNECTION SUMMARY	AVAILABLE FAULT CURRENT
ERU-1	AIR SOURCE HEAT PUMP ENERGY RECOVERY UNIT	NEW	5480	VALENT	VXC-212-FH-25A-1-A1	6000	1	5.06	7.5	1685	5400	.65	3.1	5	1429	NO	ERU-1 - 480V/3PH, 177.8 MCA, 200A OCP	22938

Energy Recovery Performance

Design Condition	Temperature (F)								Capacity Reduction (BTUh)
	Outdoor Air		Supply Air		Return Air		Exhaust Air		
	DB	WB	DB	WB	DB	WB/RH	DB	WB	
Summer	92.8	77.9	81.6	69.9	75.0	62.5/50	87.4	72.8	202,500.0
Winter	1.0	-0.6	46.0	40.3	72.0	55.7/35	22.3	20.4	291,600.0

Cooling Specifications

Type	Total Capacity (MBH)	Sensible Capacity (MBH)	Coil (DB/WB)		Reheat	
			EAT (F)	LAT (F)	Capacity (MBH)	LAT (F)
Air-Source Heat Pump	332.0	190.0	81.6 / 69.9	52.8 / 52.6	111.9	70.1

Primary Heat Specifications

Type	Total Capacity (MBH)	Dry Bulb Temperatures		
		EAT (F)	LAT (F)	Ambient Outdoor Air (F)
Air-Source Heat Pump	141.3	49.3	71.1	10.0

Secondary Heat Specifications

Type	Capacity (kW)	Full Load Amps (FLA)	Capacity Control	Performance (w/ASHP)		Performance (w/o ASHP)	
				EAT (F)	LAT (F)	EAT (F)	LAT (F)
Electric	60.0	75.31	Modulating (SCR)	71.1	102.7	46.0	77.6

HVAC VENTILATION SCHEDULE

NUMBER	NAME	AREA	LEVEL	PEOPLE	OA PER PERSON	OA PER SQ FT.	REQ SUP	ACT SUP	REQ OA	ACT OA	ACT RET	ACT EXH	CRIT OA	PRESSURE
3330	STORAGE - 23805	160 SF	Level 3	1	5	0.06	50	300	40	40	300	0	6.1	Neutral
3335	ANTE ROOM - 23806	95 SF	Level 3	0	0	0	20	40	5	5	40	0	0	Neutral
3336	MEETING - 23804	149 SF	Level 3	8	5	0.06	130	300	40	40	300	0	20.4	Neutral
3337	OFFICE (M) - 208	102 SF	Level 3	1	5	0.06	35	200	13	13	200	0	6.9	Neutral
3338	OFFICE (M) - 209	96 SF	Level 3	1	5	0.06	35	200	13	13	200	0	6.7	Neutral
3339	OFFICE (M) - 210	89 SF	Level 3	1	5	0.06	35	200	13	13	200	0	6.5	Neutral
3346	AUTOCLAVE	142 SF	Level 3	4	10	0.18	165	165	0	0	675	0	250	0	Negative
3347	MICROSCOPY	136 SF	Level 3	4	10	0.18	95	125	0	64	125	0	0	0	Neutral
3430	MICROBIOLOGY LAB	338 SF	Level 3	4	10	0.18	1075	1075	0	100	1075	200	0	Negative
3430	MICROBIOLOGY LAB	1490 SF	Level 3	30	10	0.18	725	1050	0	570	1050	650	0	Negative
TOTAL		2796 SF												

HVAC DIFFUSERS AND REGISTERS SCHEDULE

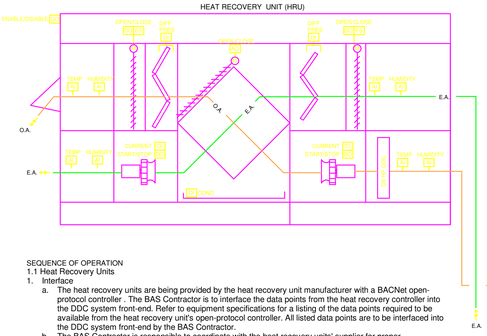
TAG	MANUFACTURER	MODEL	Size	MOUNTING	MATERIAL	FINISH	DAMPER TYPE	BORDER STYLE
CD-2	TITUS	OMNI	6"ø	CEILING	STEEL	STANDARD WHITE	BUTTERFLY	LAY IN MOUNTING
CD-5	TITUS	OMNI	14"ø	CEILING	STEEL	STANDARD WHITE	BUTTERFLY	LAY IN MOUNTING
ER-1	TITUS	45F	12"x12"	CEILING	STEEL	STANDARD WHITE	OPPOSED BLADE	LAY IN MOUNTING
ER-2	TITUS	45F	24"x24"	CEILING	STEEL	STANDARD WHITE	OPPOSED BLADE	LAY IN MOUNTING
RG-1	TITUS	45F	24"x12"	CEILING	STEEL	STANDARD WHITE	OPPOSED BLADE	LAY IN MOUNTING
RG-2	TITUS	45F	24"x24"	CEILING	STEEL	STANDARD WHITE	OPPOSED BLADE	LAY IN MOUNTING
RG-3	TITUS	45F	24"x12"	CEILING	STEEL	STANDARD WHITE	(none)	LAY IN MOUNTING
SR-2	TITUS	271HL	12"x12"	CEILING	STEEL	STANDARD WHITE	OPPOSED BLADE	(none)
SR-3	TITUS	OMNI	24"x24"	CEILING	STEEL	STANDARD WHITE	BUTTERFLY	(none)

HVAC FANS SCHEDULE

Equipment shall be braced and labeled by the equipment manufacturer to withstand the minimum scheduled available fault current value for listed equipment.

EQUIPMENT MARK	DESCRIPTION	LOCATION	STATUS	WEIGHT (lbs)	MANUFACTURER	MODEL	CFM	ESP (in WC)	EMERGENCY	ELECTRIC CONNECTION SUMMARY	AVAILABLE FAULT CURRENT
HEF-6	HVAC FAN		NEW	104	GREENHECK	USF-13-B7	725	1	NO	HEF-6 - 480V/3PH, 0.75 HP	1843

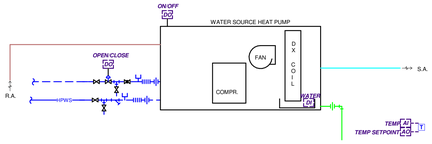
HEAT RECOVERY UNIT (HRU)



SEQUENCE OF OPERATION

1.1 Heat Recovery Units

1. Interface
   a. The heat recovery units are being provided by the heat recovery unit manufacturer with a BACNet open-protocol controller . The BAS Contractor is to interface the data points from the heat recovery controller into the DDC system front-end. Refer to equipment specifications for a listing of the data points required to be available from the heat recovery unit's open-protocol controller. All listed data points are to be interfaced into the DDC system front-end by the BAS Contractor.
   b. The BAS Contractor is responsible to coordinate with the heat recovery units' supplier for proper coordination and interfacing of all specified data points, including any and all incidental programming required for proper display/commanding of the data points specified in equipment specification as well as all additional data points listed in this section.
   c. The BAS Contractor is to do a point-by-point verification of all read/write points between the heat recovery units and the DDC system. The point-by-point verification is to be done in conjunction with the heat recovery unit equipment supplier. The heat recovery unit equipment supplier is to provide a trained technician to work in conjunction with the BAS Contractor for the point-by-point verification. The data verification only needs to be done on one of each unique type of heat recovery system on the project. The BAS Contractor is to generate a point-by-point verification form for each unique heat recovery system and submit the form(s) to the Engineer for review before proceeding with DDC system interfacing of the balance of the heat recovery units.
2. Startup
   a. Electric disconnect switch and circuit breaker shall be in the 'ON' position so that line voltage power is available at the unit. The power switch of the integral controller should be in the 'ON' position.
   b. A "Hand-Off-Auto" switch at each of the supply and exhaust fan motor starters permit manual or automatic operation of each fan.
      1. In "Auto", the fan is started and stopped by the BAS.
      2. In "Hand", the fan is started regardless of the command from the BAS unless a system safety device is activated.
   c. When the unit is energized, 24 VAC is supplied to the unit controller. The unit shall continuously operate as controlled by the BAS. If no failures or faults are detected, after 30 seconds, the unit shall commence start-up.
   d. Control and Monitoring points shall include but be limited to:
      1. Enable/Disable Heat Recovery Unit (DO)
3. Modes of Operation
   a. The ERV shall operate in one of the following modes:
      1. Normal Operation
      2. Frost Control
      3. Off
4. Supply Fan Control
   a. The supply fan shall be balanced to the scheduled supply airflow and run continuously at constant speed. Provide current transducer on supply fan motor to prove supply fan motor current.
   b. Upon "Enable" signal from the BAS, and the exhaust air fan motor operating for a minimum of 1 minute, the outside air damper shall open and be proven open via end switch prior to starting the supply fan motor.
   c. During normal operation, the outside air bypass damper shall modulate open to the heat exchanger.
   d. Provide a differential pressure sensor across the outside air filter. Alarm BAS when differential pressure xceeds setpoint of 0.5" (adjustable).
   e. Control and Monitoring points shall include but not be limited to:
      1. Supply fan motor start/stop (DO)
      2. Supply fan motor current via current sensor (DI)
      3. Outside air damper open/close (DO)
      4. Outside air damper open position via end switch (DI
      5. Entering Outside air temperature (AI)
      6. Entering Outside air humidity (AI)
      7. Leaving Outside air temperature (AI)
      8. Leaving Outside air humidity (AI)
      9. Outside air bypass damper open/close position (AO)
      10. Outside air filter differential pressure (DI)
5. Exhaust Fan Control
   a. The exhaust fan shall be balanced to the scheduled exhaust airflow and run continuously at constant speed. Provide current transducer on exhaust fan motor to prove exhaust fan motor current.
   b. Upon "Enable" signal from the BAS, the exhaust air damper shall open and be proven open via end switch prior to starting the exhaust fan motor. Exhaust fan motor shall operate for 1 minute prior to enabling the outside air fan motor to purge any condensate from the heat exchanger.
   c. Provide a high condensate alarm in the condensate pan. Upon detection of high condensate, the unit shall commence shutdown mode and alarm the BAS of high condensate levels.
   d. Provide a differential pressure sensor across the exhaust air filter. Alarm BAS when differential pressure exceeds setpoint of 0.5" (adjustable)
   e. Control and Monitoring points shall include but not be limited to:
      1. Exhaust fan motor start/stop (DO)
      2. Exhaust fan motor current via current transducer (DI)
      3. Exhaust air damper open/close (DO)
      4. Exhaust air damper open position via end switch (DI)
      5. Entering Exhaust air temperature (AI)
      6. Entering Exhaust air humidity (AI)
      7. Leaving Exhaust air temperature (AI)
      8. Leaving Exhaust air humidity (AI)
      9. High condensate level alarm (DI)
      10. Exhaust air filter differential pressure (DI)
6. Supply Air Temperature Setpoint
   a. The supply air temperature setpoint shall be set 55 degrees F (adjustable).
   b. All setpoints shall be adjustable through the FMS.
   c. Modify setpoints to maintain condition comfort.
7. Economizer Control
   a. Economizer control shall be enabled whenever the outside air enthalpy is lower than the return air enthalpy. Enthalpy shall be calculated from sensors which are tied to the same controller for accuracy. During economizer mode, the energy recovery wheel shall be modulated off, the supply fan and exhaust fan are on.
8. Cooling/Heating Control
   a. Cooling and heating shall be controlled based on leaving enthalpy wheel supply temperature whenever the system fans are proven on. If the economizer mode is disabled, enable the enthalpy wheel and compressor. When the leaving enthalpy wheel supply temperature drifts from setpoint and the enthalpy wheel is at full speed, modulate the compressor to maintain leaving supply air temperature setpoint. Control the reversing valve to provide heating or cooling as needed.
      1) Compressor start/stop (AO)
      2) Compressor capacity status (AI)
      3) Compressor reversing valve (DO)
9. Frost Control
   a. To prevent frost or ice build up on the heat exchanger, the face and bypass damper position shall modulate and bypass outside air around the heat exchanger.
   b. When the discharge exhaust air temperature is at or below 40 deg. F (adjustable), the outside air bypass damper shall modulate open and bypass outside air around the heat exchanger.
   c. Control and Monitoring points shall include but not be limited to:
      1. Exhaust air discharge temperature (AI)
      2. Outdoor air bypass damper open/close position (AO)
10. Shutdown
   a. At shutdown, the unit shall go into fail safe position. Fail safe position is defined by the following: the outside air and exhaust fan motors are off, the outside air and exhaust dampers are closed and the outside air bypass damper shall be closed to the heat exchanger.
11. BAS Alarms
   a. The BAS shall generate an alarm whenever the following conditions occur:
      1. The outside air fan motor is commanded on but fails to run (fan motor's current transducer indicates the fan motor is off for more than 60 seconds).
      2. The outside air fan motor is commanded off but continues to run (fan motor's current transducer indicates the fan motor is running for more than 60 seconds).
      3. The exhaust fan motor is commanded on but fails to run (fan motor's current transducer indicates the fan motor is off for more than 60 seconds).
      4. The exhaust fan motor is commanded off but continues to run (fan motor's current transducer indicates the fan is running for more than 60 seconds).
      5. The leaving outside air temperature is less than 40 degrees F or greater than 90 degrees F for more than 15 minutes.
      6. The leaving outside air humidity is less than 5% RH or greater than 95% RH for more than 60 minutes.
      7. The entering exhaust air temperature is less than 50 degrees F or greater than 80 degrees F for more than 15 minutes.
      8. The entering exhaust air humidity is less than 10% RH or greater than 70% RH.
      9. The leaving exhaust air temperature is below 35 degrees F for more than 15 minutes.
      10. The pressure drop across the outside air filter exceeds setpoint of 1.0" WC (adjustable).
      11. The pressure drop across the exhaust air filter exceeds setpoint of 1.0" WC (adjustable).
      12. The outside air damper is commanded open but fails to open in less than 90 seconds.
      13. The exhaust air damper is commanded open but fails to open in less than 90 seconds.
      14. The high condensate sensor senses high water in the condensate pan.
      15. The return air temperature is less than 50 degrees F or greater than 80 degrees F for more than 15 minutes.
      16. The return air humidity is less than 10% RH or greater than 70% RH.

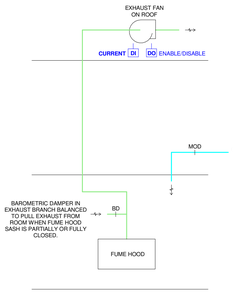


SEQUENCE OF OPERATION

1.1 GUEST ROOM WATER SOURCE HEAT PUMP SYSTEMS

A. Water Source Heat Pumps with Pre-Conditioned Outside Air

1. Interface
   a. The water-source heat pump controllers shall be furnished to the water source heat pump manufacturer and be installed by the water source heat pump manufacturer. The thermostats shall be furnished by the EMS contractor and installed and wired by the mechanical contractor. The BAS Contractor has no scope pertaining to the guest room heat pumps.
   b. The EMS system contractor is responsible to coordinate with the heat pump supplier for proper coordination and interfacing of all specified data points, including any and all incidental programming required for proper display/commanding of the data points specified in equipment spec as well as all additional data points listed in this section.
   c. The EMS Contractor is to do a point-by-point verification of all read/write points between the heat pumps and the DDC system. The point-by-point verification is to be done in conjunction with the heat pump equipment supplier. The heat pump equipment supplier is to provide a trained technician to work in conjunction with the EMS contractor for the point-by-point verification. The data verification only needs to be done on one of each unique type of heat pump on the project. The EMS contractor is to generate a point-by-point verification form for each unique heat pump and submit the form(s) to the Engineer for review before proceeding with EMS interfacing of the balance of the heat pumps.
2. Startup
   a. The unit shall operate on an occupied/unoccupied cycle as controlled from the EMS. Occupancy shall be predetermined by and programmed into the EMS.
   b. Provide a 5 minute (adjustable) time delay on compressor start during unoccupied mode to insure flow.
3. Supply Fan Control
   a. The supply fan speed shall be constant and set to the required CFM.
4. Space Temperature Control
   a. EMS Contractor shall provide local wall mounted room temperature sensor with display of room t emperature and setpoint (+/- 3 deg. F. adjustable from setpoint determined by EMS) and local occupant override feature (3 hours adjustable thru EMS). Water source heat pump heating and cooling shall be controlled to maintain space temperature setpoint.
5. Cooling Control
   a. Cooling shall be controlled to maintain space temperature setpoint. On a call for cooling, the supply fan motor shall start, the 2-way heat pump water control valve shall open, the reversing valve shall move to the cooling position and compressor(s) shall be staged on.
6. Heating Control
   a. Heating shall be controlled to maintain space temperature setpoint. On a call for heating, the supply fan motor shall start, the 2-way heat pump water control valve shall open, the reversing valve(s) shall move to the heating position and compressor(s) shall be staged on.
7. Restart
   a. Provide automatic restart of system upon failure for 2 attempts (adjustable)
   b. After 2 attempts, alarm system and require manual reset.
8. Condensate Overflow
   a. Provide a high condensate sensor in the condensate pan. Upon detection of high condensate in the condensate pan, shut down water source heat pump and alarm the EMS.
9. Unoccupied Mode
   a. During the unoccupied mode of operation, the heat pump shall go into night setback.
10. Night Setback/Shut Down
   a. At night setback/shutdown the heat pump shall go to fail safe position. Fail safe position is defined by the following: The supply fan is off, the compressor(s) are off. The supply fan shall cycle in conjunction with either the heating or cooling system to maintain a minimum/maximum space temperature depending on the season.



SEQUENCE OF OPERATION

A. FUME HOOD EXHAUST

1. The fume hood exhaust fan shall be manually controlled at the hood. When hood is in on position, fan shall energize.
2. Outside air into space to be tied to fume hood operation. When hood and fan are energized, outside air two-position motor operated damper to be open to allow noted outside air flow. When fume hood is off, damper to close.

ARCX STUDIO

ARCHITECT & INTERIOR DESIGN

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ARCX STUDIO PROJECT NUMBER

2325

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STATE OF OHIO
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REGISTERED
PROFESSIONAL ENGINEER
7/31/2024

REVISION

Δ	DESCRIPTION	DATE
1	REVISION 1	02.23.24
2	BULLETIN 09	07.31.24

ISSUED FOR

BID & PERMIT
01-17-2024

SHEET NAME

MECHANICAL - SCHEDULES

SHEET NO.

M6.71

THIS SHEET WHEN PLOTTED AT FULL SIZE MEASURES 30" X 42"

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DRAWN BY: Author CHECKED BY: Checker

COMcheck Software Version COMcheckWeb
Mechanical Compliance Certificate

Project Information

Energy Code:	2012 IECC
Project Title:	Medpace B200 Microbiology
Location:	Cincinnati, Ohio
Climate Zone:	4a
Project Type:	Alteration

Construction Site: Owner/Agent: Designer/Contractor:

Mechanical Systems List

Quantity System Type & Description

1 HRU-1 (Single Zone):
Single Package Heat Pump
Heating Mode: Capacity = 55 kBtu/h,
Proposed Efficiency = 3.43 COP, Required Efficiency = 3.30 COP
Cooling Mode: Capacity = 97 kBtu/h, , Air Economizer
Proposed Efficiency = 11.30 EER, Required Efficiency = 11.00 EER
Proposed Part Load Efficiency = 20.10 IEER, Required Part Load Efficiency = 11.20 IEER
Fan System: FAN SYSTEM 1 -- Compliance (Motor nameplate HP and fan efficiency method) : Passes

Fans:
Exhaust fan Exhaust, Constant Volume, 1650 CFM, 1.0 motor nameplate hp
Supply fan Supply, Constant Volume, 1910 CFM, 1.5 motor nameplate hp

Mechanical Compliance Statement

Compliance Statement: The proposed mechanical alteration project represented in this document is consistent with the building plans, specifications, and other calculations submitted with this permit application. The proposed mechanical systems have been designed to meet the 2012 IECC requirements in COMcheck Version COMcheckWeb and to comply with any applicable mandatory requirements listed in the Inspection Checklist.

Name - Title Signature Date

Additional Comments/Assumptions:

COMcheck Software Version COMcheckWeb
Inspection Checklist

Energy Code: 2012 IECC

Requirements: 100.0% were addressed directly in the COMcheck software

Text in the "Comments/Assumptions" column is provided by the user in the COMcheck Requirements screen. For each requirement, the user certifies that a code requirement will be met and how that is documented, or that an exception is being claimed. Where compliance is itemized in a separate table, a reference to that table is provided.

Section # & Req.ID	Plan Review	Complies?	Comments/Assumptions
C103.2 [PR2][1]	Plans, specifications, and/or calculations provide all information with which compliance can be determined for the mechanical systems and equipment and document where exceptions to the standard are claimed. Load calculations per acceptable engineering standards and handbooks.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.

Additional Comments/Assumptions:

Section # & Req.ID	Final Inspection	Complies?	Comments/Assumptions
C403.2.4.1 [FI47][1]	Heating and cooling to each zone is controlled by a thermostat control. Minimum one humidity control device per installed humidification/dehumidification system.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.
C403.2.4.2 [FI38][1]	Thermostatic controls have a 5 °F deadband.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.
C403.2.4.2 [FI20][1]	Temperature controls have setpoint overlap restrictions.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.
C403.2.4.3 [FI39][1]	Each zone equipped with setback controls using automatic time clock or programmable control system.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.
C403.2.4.3 [FI40][1]	Automatic Controls: Setback to 55°F (heat) and 85°F (cool); 7-day clock, 2-hour occupant override, 10-hour backup	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.
C403.2.4.3.3 [FI41][1]	Systems include optimum start controls.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.
C403.2.4.3.1 [FI42][1]	Heat pump controls prevent supplemental electric resistance heat from coming on when not needed.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.
C408.2.5.1 [FI7][1]	Furnished HVAC as-built drawings submitted within 90 days of system acceptance.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.
C303.3, C408.2.5.3 [FI8][1]	Furnished O&M manuals for HVAC systems within 90 days of system acceptance.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.
C408.2.5.3 [FI43][1]	An air and/or hydronic system balancing report is provided for HVAC systems.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.
C408.2.3.2 [FI10][1]	HVAC control systems have been tested to ensure proper operation, calibration and adjustment of controls.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.
C403.2.2 [FI27][1]	HVAC systems and equipment capacity does not exceed calculated loads.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.

Section # & Req.ID	Footing / Foundation Inspection	Complies?	Comments/Assumptions
C403.2.4.5 [FO9][1]	Freeze protection and snow/ice melting system sensors for future connection to controls.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	**Exception:** Requirement does not apply.

Additional Comments/Assumptions:

Section # & Req.ID	Final Inspection	Complies?	Comments/Assumptions
C408.2.1 [FI28][1]	Commissioning plan developed by registered design professional or approved agency.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.
C408.2.4 [FI29][1]	Preliminary commissioning report completed and certified by registered design professional or approved agency.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.
C408.2.5.4 [FI30][1]	Final commissioning report due to building owner within 90 days of receipt of certificate of occupancy.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.
C408.2.3.1 [FI31][1]	HVAC equipment has been tested to ensure proper operation.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.
C408.2.3.3 [FI32][1]	Economizers have been tested to ensure proper operation.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.

Additional Comments/Assumptions:

Section # & Req.ID	Mechanical Rough-In Inspection	Complies?	Comments/Assumptions
C403.2.3 [ME55][2]	HVAC equipment efficiency verified.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	*See the Mechanical Systems list for values.*
C403.2.5.1 [ME59][1]	Demand control ventilation provided for spaces >500 sq.ft. and >25 people/1000 sq.ft. occupant density and served by systems with air side economizer, auto modulating outside air damper control, or design airflow >3,000 cfm.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	**Exception:** Systems with energy recovery.
C403.2.7 [ME60][2]	HVAC ducts and plenums insulated. Where ducts or plenums are installed in or under a slab, verification may need to occur during Foundation Inspection.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.
C403.2.8.1 [ME7][1]	Piping insulation exposed to weather is protected from damage (due to sun, moisture, wind, etc.).	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.
C403.2.8 [ME41][1]	Thermally ineffective panel surfaces of sensible heating panels have insulation >= R-3.5.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.
C403.2.7 [ME10][2]	Ducts and plenums sealed based on static pressure and location.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.
C403.2.7.1.3 [ME11][1]	Ductwork operating >3 in. water column requires air leakage testing.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	**Exception:** Requirement does not apply.
C403.3.1, C403.3.1.1 [ME62][1]	Air economizers provided where required, meet the requirements for design capacity, control signal, ventilation controls, high-limit shut-off, integrated economizer control, and provide a means to relieve excess outside air during operation.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.
C408.2.2.1 [ME53][1]	Air outlets and zone terminal devices have means for air balancing.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.
C403.4.2 [ME66][2]	VAV fan motors >=7.5 hp to be driven by variable speed drive, have a vane-axial fan with variable pitch blades, or have controls to limit fan motor demand.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	**Exception:** Requirement does not apply.
C403.2.6 [ME57][1]	Exhaust air energy recovery on systems meeting Table C403.2.6	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	Requirement will be met.
C403.2.11 [ME71][2]	Unenclosed spaces that are heated use only radiant heat.	☐Complies ☐Does Not ☐Not Observable ☐Not Applicable	**Exception:** Requirement does not apply.

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ENGINEER

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B200 MICROBIOLOGY RENOVATION LEVEL 03

5365 MEDPACE WAY
CINCINNATI OH 45227

ARCX STUDIO PROJECT NUMBER

2325

OWNER

STATE OF OHIO
KRIS T. SCHNITGEN
E-77432
REGISTERED
PROFESSIONAL ENGINEER
1/19/2024

REVISION

△	DESCRIPTION	DATE

ISSUED FOR

BID & PERMIT 01-19-2024

SHEET NAME

MECHANICAL COMPLIANCE CHECK

SHEET NO.

M8.71

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SECTION 23 05 01.00 – COMMON REQUIREMENTS FOR HVAC

General
General Provisions of the Contract including General and Supplementary Conditions and General Requirements apply to work of this section.
Scope
The base bid includes furnishing all materials, labor, tools, and equipment and the performance of all work required to install a complete heating and air conditioning system as outlined herein.
Guarantee
The contractor shall provide a guarantee in written form stating that all work under this section shall be free of defective work, materials, or parts for a period of one year from the date of owner's final acceptance and shall repair, revise or replace at no cost to the owner any such defects occurring within the guarantee period. Contractor shall also state in written form that any items or occurrences arising during the guarantee period will be attended to in a timely manner and will in no case exceed four (4) working days from date of notification by owner.
Quality Assurance
Provide a complete installation in conformance with the following standards.
ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers
NFPA: National Fire Protection Association
SMACNA: Sheet Metal and Air Conditioning Contractors National Association.
Statewide Building Code
IMC: International Mechanical Code
Permits, Fees, Inspections, Laws and Regulations
Permits and fees of every nature required in connection with this work shall be obtained and paid for by this contractor who shall also pay for all the installation fees and similar charges. Laws and regulations, which bear upon or affect the various branches of this work shall be complied with by this contractor and are hereby made a part of this contract. All work, which such laws require to be inspected, shall be submitted to the proper public official for inspection and a certificate of final approval must be furnished.
Work in Existing Spaces
General: Care shall be taken when working in existing spaces so as not to damage existing walls and ceilings where work is being performed.
Ceilings: Where work is being performed above ceilings, and the architectural drawings do not indicate ceiling modifications by the general contractor, it shall be the responsibility of this contractor to remove and replace existing ceilings where work is being performed. In those instances, all repair and installation of new grid, ceiling panels, etc shall be the responsibility of this contractor. Match existing finishes.
Walls & Floors: It shall be the responsibility of this contractor to patch existing walls and floors and match existing finishes where work is being removed or installed and patching is being performed, unless noted otherwise on the architectural drawings.
Demolition
Any Equipment to be demolished shall also include the demolition of any and all ductwork, piping etc serving or served by the equipment, all accessories, air devices, wiring, gas piping, venting, control wiring and power wiring associated with the equipment.
Demolition shall be coordinated with all trades. All materials shall be turned over to the owner or disposed at the owner's direction.
Contractor is responsible for reclaiming any refrigerant in association with the demolition in accordance with all local, state and federal regulations.
Any roof or wall penetration shall be patched watertight to the satisfaction of the architect.
Tests and Adjustments
No ducts, piping, fixtures or equipment shall be concealed or covered until they have been inspected and approved by the Architect and the inspector who shall be notified by the contractor when the work is ready for inspection.
Work shall be completely installed, tested and leak tight before inspection is required. All tests shall be repeated to the satisfaction of those making the inspection.
Architectural coordination items
Cutting and Patching: Cut and drill all openings in walls and floors required for the installation. Secure approval of Engineer before cutting and drilling. Neatly patch all openings cut.
Fire Caulking: Patching through fire rated walls and enclosures shall not diminish the rating of that wall or enclosure. Patch shall be equal to rockwool, firestop, caulk or approved "rated" patch.
Access Panels and Pathways: Furnish all access panels required for proper servicing of equipment. Provide access panels for all concealed valves, vents, controls, cleanout doors, and sprinkler devices required by NFPA. Provide access panels for all fire and/or fire & smoke dampers. Provide frame as required for finish. Furnish panels to General Contractor. Exact locations to be approved by the Architect. Minimum size to be 12" x 12", units to be 16 gauge steel, locking device shall be screwdriver cam locks.
project conditions
Where new HVAC systems are required to be connected to existing HVAC systems, it is the contractor's responsibility to verify the location, size, pressure, condition, and they shall verify that the existing HVAC system is indeed the correct and appropriate HVAC system before any work is done. Provide all necessary camera scoping and dye testing as necessary. If there is any need for concern, if it is determined that the existing HVAC system is not a correct or appropriate HVAC system or not connected to a correct or appropriate HVAC system, if the condition of the existing HVAC system is not viable for re-use, or any other condition that would not allow the proper functioning of the new HVAC system, the contractor shall notify the engineer in writing immediately via RFI and wait for direction before proceeding.
Interruption of Existing HVAC Services: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
Notify, Architect, Construction Manager, and Owner no fewer than seven days in advance of proposed interruption of service.
Do not proceed with interruption of service without Architect's written permission.
DELEGATED DESIGN
For equipment supports, this contractor shall retain a qualified professional engineer to provide support calculations of static and dynamic loading due to operating equipment weight. The signed and sealed calculations and details shall be submitted by the retained professional engineer.
MECHANICAL EQUIPMENT COMMON REQUIREMENTS
INSPECTION
Examine areas and conditions under which mechanical equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.
Uncrate equipment and inspect for damage. Verify that nameplate data corresponds with unit designation.
INSTALLATION
General: Install mechanical equipment as indicated, and in accordance with manufacturer's installation instructions.
Location: Install each unit level/plum and accurately in position indicated in relation to other work; and maintain sufficient clearance for normal service and maintenance, but in no case less than that recommended by manufacturer.
Coordinate with other trades to assure correct recess size for recessed units.
Protect interior mechanical equipment with protective covers during balance of construction.
For ducted equipment, connect ductwork to units with flexible duct connections. Provide transitions to exactly match unit duct connection size. Provide 1" acoustic duct lining on return air side a minimum of 10' from fan.
Piping: Restrictors or piping changes shall be made as necessary to achieve manufacturers recommended pressure drops. The findings shall be reported to the engineer at project closeout.
Provide trap at drain piping connection to unit sized per manufacturer's recommendations.
Access: Provide access space around and over mechanical equipment for service as indicated, but in no case less than that recommended by manufacturer or required by code in effect.
Access Panels: Furnish all access panels required for proper servicing of equipment. Provide access panels for all concealed valves, vents, controls and cleanout doors, and sprinkler devices required by NFPA. Provide frame as required for finish. Furnish panels to General Contractor. Exact locations to be approved by the Architect. Minimum size to be 12" x 12", units to be 16 gauge steel, locking device shall be screwdriver cam locks.
Rooftop mechanical equipment shall be installed a minimum of 10'-0" from any roof edge regardless of location indicated on plans, unless a screen wall or railing is installed per the local building code. See the architectural plans for coordination.
Roof Curbs: Furnish roof curbs to roofing Installer for installation. Install and secure roof curb to roof structure, in accordance with National Roofing Contractor's Association (NRCA) installation recommendations and shop drawings. Install and secure units on curbs and coordinate roof penetrations and flashing. Install according to roofing manufacturer's recommendation and specifications.
Rooftop supports: Provide rooftop equipment rails for mechanical equipment located on the roof that spans two or more bar joists. Verify roof structure, mounting supports, and membrane installations are completed to the proper point to allow installation of roof mounted units.
Indoor Suspended Equipment: Install suspended from structure with all threaded rod and vibration isolators.
ELECTRICAL COORDINATION ITEMS
Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.
Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.
Install electric heating terminal units including components in accordance with equipment manufacturer's written instructions, and with recognized industry practices; complying with applicable installation requirements of NEC and NECA's "Standard of Installation".
Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std 486A.
Grounding: Provide equipment grounding connections for electric heating terminals as indicated. Tighten connections to comply with tightening torque values specified in UL Std 486A to assure permanent and effective grounding.
FIELD QUALITY CONTROL
Testing: After installation has been completed, test to demonstrate proper operation of mechanical equipment at performance requirements specified. When possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units, which cannot be satisfactorily corrected. Test controls and demonstrate compliance with requirements.
Cleaning: After construction is completed, including painting, clean unit exposed surfaces, vacuum clean coils and inside of cabinets. Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.
START-UP
Provide the services of a factory-authorized service representative to start-up rooftop units, in accordance with manufacturer's written start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
TRAINING OF OWNER'S PERSONNEL
Provide services of manufacturer's technical representative for 1-half day to instruct Owner's personnel in operation and maintenance of units. Schedule training with Owner, provide at least 7-day notice to Contractor and Engineer of training date.

SECTION 23 05 03.00 – SUBMITTALS FOR HVAC

General
Where submittals are required by the Contract Documents, they shall be prepared and supplied in accordance with the Contract Documents. In addition to Division 01, the Contractor is advised to review and comply with the requirements articulated within each Division and within each section of that Division.
Some Divisions may include a division-specific "Submittal Requirements for ...." section. Where this section exists, it articulates additional requirements for submittals that apply to the work of that Division.
The following requirements help to identify, track and keep the project organized for all parties involved. They are necessary to ensure a timely turnaround and an appropriate technical review. Submittals that do not conform to the administrative requirements are rejected and returned, without technical review.
Requirements
Supply submittals for each section: Submittals shall be supplied on a section-by-section and type-by-type basis. For example, independent product data submittals shall be furnished for each section that requires product data submittals. Independent shop drawing submittals shall be furnished for each section that requires shop drawings.
Refer to the specifications for identification of which submittals are required for the project. Separate PDF file packages shall be supplied for each section, for each submittal type, where electronic submittals are required. Each PDF shall represent a single standalone submittal. Separately bound and identified submittals shall be provided where hardcopies are required.
Include a transmittal: Transmittals shall enumerate each submittal for each section of each type and iteration.
Include cover sheet / title page: The cover sheet shall include the information identified in the contract documents. It shall be included as the first page of each electronic and/or hardcopy document-based submittal. An editable and printable PDF form created with editable fields and specification compliant appearance is available from KLH upon request. It is also downloadable from the KLH website at www.klhengrs.com.
Include an index: The index shall enumerate the contents of the submittal.
Include checklists: Where checklists are included with the specifications, complete and include them within the appropriate submittal. Supply complete submittals:
Complete submittals of each type are required. Partial submittals will be rejected. Where a section requires a product data submittal, all product data for that section shall be supplied together, at one time, as one complete submittal. Do not send half the product data as one submittal and the other half as a separate one. When resubmittal is required (e.g. Revise and Resubmit) the revised submittal shall be more complete, more accurate and more contract-compliant than its rejected predecessor. The submittal number (for each section and type) shall increment for each subsequent submittal (00 – Original submission, 01 – First Resubmission, 02 – Second Resubmission, etc...). Resubmittals shall include a copy of the reviewer's comments supplied with the prior submittal rejection and shall be amended with a description of the specific action taken to comply with the reviewer's comments. The absence of this on resubmittal is cause for rejection.
Name electronic files to match the submittal ID and cover sheet: The electronic file name of submittals shall match the submittal ID included on the submittals cover page. For example: The original/first product data submittal for Section 234116 would be labeled as "234116.00-PD-00"; the first resubmittal of same shall be labeled "234116.00-PD-01". The original/first shop drawings submittal file for the same section would be labeled "234116.00-SD-00"; the first resubmittal of same shall be labeled "234116.00-SD-01".
Use of Electronic Drawings from the Owner's Design Team
Plan drawings for the Project were created with AutoCAD and Revit.
If expressly permitted by the Owner and the terms of the Contract, editable electronic versions of standard-scale, AutoCAD-based plan drawings may be made available for the creation of shop and as-built drawings.
Upon request when available, electronic versions of standard-scale, Navisworks (.dwf) and (.nwc) or AutoCAD 36 (.dwg) files may be made available for coordination purposes.
Due to the proprietary nature of internal design systems, editable native-software versions of some drawings, including but not limited to system diagrams and details will not be made available in an editable form. In these cases, electronic versions of the drawings may be made available only in PDF, JPG or similar non-editable electronic form, at the sole discretion of the Design Professional.
The Request Drawings form can be accessed, filled out and submitted at the following internet address (scroll down to bottom of home page): http://www.klhengrs.com.

SECTION 23 05 29.00 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

Submittal Requirements
Product Data: For each type of product indicated.
Shop Drawings: Fabrication and installation details.

General
Support all piping, ductwork and equipment by hangers or brackets properly from the building structure. Support from decking above is prohibited. Furnish structural steel members where required to support piping and equipment. No portion of piping or valves shall be supported by equipment.
Ductwork - Support by means of hangers as follows:

Duct Width	Hanger Size and Type	Max. Spacing
30 or less	(#16 gage)	8

A pair of hangers shall be located at every transverse joint and elsewhere according to the table.
Piping
Install hangers, supports, clamps and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible. Where piping of various sizes is supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe as specified above for individual pipe hangers.
Individual pipe hangers to be Anvil International Clevis Hanger Fig. 260, Elcen, or approved equal.
Rod sizes to conform to the following: 3/8" rods for 3/4"-2" pipe; 1/2" rods for 2-1/2"-3" pipe; 5/8" for 4"-5" pipe and 3/4" for 6" pipe.
Hangers shall be sized to allow insulation to pass through unobstructed, provide saddle support for insulation at all hanger.
Hanger spacing for steel piping unless otherwise noted is to be as follows: 1-1/4" or smaller to be 8' on center; 1-1/2"-2" to be 10' on center; 2-1/2" and larger to be 12' on center and at each change of direction. Hanger spacing for copper pipe to be as follows: 1" or smaller 6' on center; 1-1/4" or larger 8' on center.
Piping shall be also supported at each change in direction, at valves, and at equipment.

SECTION 23 05 93.00 – TESTING, ADJUSTING AND BALANCING FOR HVAC

Submittal Requirements
Shop Drawings: Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Final Report: Upon verification and approval prepare final reports, type written, and organized and formatted as specified below. Submit 2 complete sets of final report to the owner.

General
Test, adjust, and balance the following mechanical systems:
Supply air systems, all pressure ranges
Return air systems.
Exhaust air systems.
Hydronic systems.
Verify temperature control system operation.
Test systems for proper sound and vibration levels.
Quality Assurance
Codes and Standards:
AABC: "National Standards for Total System Balance".
ASHRAE: ASHRAE Handbook, 2011 Applications, Chapter 38, Testing, Adjusting, and Balancing.
Qualifications
The contractor shall procure the services of an independent Balance and Testing Agency, approved by the Engineer, and a member of Associated Air Balance Council (AABC) or NEBB, which specializes in the balancing and testing of heating, ventilating and air conditioning systems, to balance, adjust and test all air and water systems and equipment as herein specified. All work by this agency shall be done under direct supervision of a qualified heating and ventilating Engineer employed by this agency. All instruments used by this agency shall be accurately calibrated and maintained in good working order.
Sequencing and Scheduling
Test, adjust, and balance the air systems before hydronic, steam, and refrigerant systems.
Test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within 5 deg F wet bulb temperature of maximum summer design condition, and within 10 deg F dry bulb temperature of minimum winter design condition.
Take final temperature readings during seasonal operation.
Check all filters for cleanliness, provide new as required.
Check dampers (volume and fire) for correct and locked position, and temperature control for completeness of installation before starting fans. Place outlet dampers in full open position. Lubricate all motors and bearings.
Check fan belt tension. Check fan rotation.
Open valves to full open position. Remove and clean all strainers. Set temperature controls so all coils are calling for full flow.
Air balance and testing shall not begin until the system has been completed and is in full working order. The Contractor shall put all heating, ventilating and air conditioning systems and equipment into full operation and shall continue the operation of same during each working day of testing and balancing. The contractor shall submit within 30 days after receipt of contract, 8 copies of submittal data for the testing and balancing of the air conditioning, heating, and ventilating systems. The Air Balance and Testing Agency shall provide proof of having successfully completed at least five projects of similar size and scope.
The air balancing contractor shall include the additional cost to change every fan factory installed sheave, pulley and/or belt of in order to obtain the design air flows.
Renovations: In areas where existing HVAC equipment is being utilized, balancing contractor shall include the cost to pre-check each equipment air flows, serving the area of work, prior to demolition, and re-check and adjust each air handler after new construction. Air flows of existing air handlers serving existing spaces shall be similar after project is complete.
Performing Testing, Adjusting and Balancing
Perform testing and balancing procedures on each system identified, in accordance with the detailed procedures outlined in the referenced standards.
Cut insulation, ductwork, and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.
Patch insulation, ductwork, and housings, using materials identical to those removed.
Seal ducts and piping, and test for and repair leaks.
Seal insulation to re-establish integrity of the vapor barrier.
Mark equipment settings, including damper control positions; valve indicators, fan speed control levers, and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.
Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

SECTION 23 07 13.00 – DUCT INSULATION

Submittal Requirements
Product Data: For each product indicated.
Shop Drawings: Include plans, elevations, sections, details and attachments to other work.

All liners, insulation and adhesives shall have a flame spread index not more than 25 and a smoke developed index of not more than 50. Insulation shall have a minimum installed thermal resistance value of R6 or code minimum, whichever higher.
Rigid Fiberglass Ductwork Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, without facing and with vapor barrier all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.
Flexible Fiberglass Ductwork Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, without facing and with vapor barrier all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.
Vapor Barrier Material for Ductwork: Paper-backed aluminum-foil, except as otherwise indicated; strength and permeability rating equivalent to factory-applied vapor barriers on adjoining ductwork insulation, where available; with following additional construction characteristics:
High Puncture Resistance: Low vapor transmission (for ducts in exposed areas: Mech. Rooms, etc.)
Moderate Puncture Resistance: Medium vapor transmission (for ducts in concealed areas).
All ductwork shall be insulated except:
Double wall ductwork
Fabric ductwork
Metal ducts with duct liner of sufficient thickness to comply with energy code.
Factory insulated flexible ductwork
Factory insulated plenums and casings
Flexible connectors
Vibration control devices
Factory insulated access panels and doors
Supply ductwork exposed in conditioned spaces excluding mechanical rooms, server rooms and electric equipment rooms
Toilet exhaust, general exhaust and return ductwork in an insulated joist or attic space.

SECTION 23 07 19.00 – HVAC PIPING INSULATION

Submittal Requirements
Product Data: For each type of product indicated.

Provide 1" fiberglass insulation on condenser water supply and return piping
Provide 1" fiberglass insulation on concealed condensate drain piping.
Insulation shall have a minimum thickness as required by Code.
All insulation and adhesives shall have a flame spread index not more than 25 and a smoke developed index of not more than 50.

SECTION 23 31 13.00 – METAL DUCTS

Submittal Requirements
Product Data: For liners, adhesives, sealants and gaskets.
Shop Drawings: Sheet metal thickness, reinforcing details, duct layouts indicating sizes, configuration, liner material, elevation and static pressure class.

Ductwork Materials
Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, stains and discolorations, and other imperfections, including those which would impair painting. Mechanical contractor shall confirm ductwork paint scope and color with architect.
Exposed ductwork which is to be painted shall have paint grip applied and be oil free.
Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized steel sheet steel, lock forming quality; with G 90 zinc coating and mill phosphatized for exposed locations. Minimum gauge shall be 24.
Miscellaneous Ductwork Materials
Volume Dampers: Provide volume dampers in all branch ducts or as required for balancing to required air flows.
Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15 deg. change of direction per section. Unless specifically detailed otherwise, use 45 deg. laterals and 45 deg. elbows for branch takeoff connections. Where 90 deg. branches are indicated, provide conical type tees.
Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork.
Duct Cement: Non-hardening migrating mastic or liquid neoprene based cement, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for cementing fitting components, or longitudinal seams in ductwork.
Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.
Flexible Ducts
Either spiral-wound spring steel with flameproof vinyl sheathing, or corrugated aluminum. Unless specifically mentioned, the maximum length of flex duct on the supply equals 5 feet. Flex is not allowed for return, relief or exhaust applications. The flexible ducts indicated for use in the H.V.A.C. system shall conform to the requirements of UL 181 for Class 0 or Class 1 flexible air ducts and shall be so identified.
Where installed in unconditioned spaces other than return air plenums, provide 1" thick 1-1/2 lb. continuous flexible fiberglass sheath with vinyl vapor barrier jacket.
Installation is not permitted above drywall ceilings and inaccessible ceilings.
Fabrication
Shop fabricate ductwork in 4, 8, 10 or 12-ft lengths, unless otherwise indicated or required to complete runs. All ductwork shall be Pittsburgh Construction with a minimum of thickness of 24 gauge. In addition, ductwork used in systems over 3" W.G. shall have cold sealant applied.
Shop fabricate ductwork of gauges and reinforcement complying with SMACNA "HVAC Duct Construction Standards".
Lined Duct
Fabricate ductwork with duct liner in each section of duct where indicated. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining and adhesive, and fasten with mechanical fasteners.
Duct liner to be 3-lb density for acoustic requirements 1" thick or as noted. Size of ductwork shown on the drawings is free net area, outside dimension of ducts will need to be increased if lined duct is used.
Size of ductwork shown on the drawings is free net area, outside dimension of ducts will need to be increased if lined duct is used.
Duct Liner: Fibrous glass of thickness indicated. 3-lb density. All liners, insulation and adhesives shall have a flame spread index not more than 25 and a smoke developed index of not more than 50.
Duct Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
Duct Liner Fasteners: Comply with SMACNA HVAC Duct Construction Standards.
Installation of Metal Ductwork
General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight (5% leakage for systems rated 3" and under; 1% for systems rated over 3") and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints.
Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth.
Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor.
Sealing: Seal all longitudinal seams, S's and drives and all joints with mastic or cement. Install according to SMACNA standards.
Balancing Dampers: The sheet metal contractor shall be fully responsible for installing balancing dampers in the ductwork, (whether shown on the drawing or not) in order to arrive at the intended air flow. The balancing sub-contractor shall provide direction and assistance in determining locations where dampers are required.
Additional dampers, if required shall be installed at no additional cost to the owner.
Wall Penetrations: Seal and pack around all ducts and piping sleeves which pass through walls that extend to bottom side of structure and rated walls.
Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.
Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown.
Coordinate layout with suspended ceiling and lighting layouts and similar finished work.
Electrical Equipment Spaces: Do not route ductwork through transformer vaults and their electrical equipment spaces and enclosures.
Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2". Fasten to duct and substrate.
Where ducts pass through fire-rated floors, walls, or partitions, provide fire dampers and firestopping between duct and substrate, in accordance with requirements of Division-7 Section "Firestopping".
All fire dampers shall be listed and comply with UL 555.
All dampers shall be low leakage with edge and blade seals. Damper manufacturers are subject to specification compliance. Provide products by one of the following:
Greenheck Fan Corporation
Nailor Industries
Pottorff
Ruskin Company
Young Regulator Company
Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.
Installation of Duct Liner
General: Install duct liner in accordance with SMACNA HVAC Duct Construction Standards. Size of ductwork shown on the drawings is free net area, outside dimension of ducts will need to be increased if lined duct is used.
Store internally lined ductwork up off of the floor. Protect internally lined ductwork from water and dust.
The following ductwork shall be lined in addition to that shown per plans:
Return from open ceiling plenum return to HVAC unit.
Supply and return ductwork 10 feet downstream of HVAC unit.
Transfer air ducts.
Butter the leading edge of all internal duct lining with the manufacturer's recommended adhesive.
Inspect and repair all damaged lining prior to installation of ductwork.
Installation of Flexible Ducts
Maximum Length: For any duct run using flexible ductwork, do not exceed 5' - 0" extended length.
Installation shall have smooth full radius turns down to diffuser.
Installation not permitted above inaccessible ceilings.

SECTION 233416.00 - CENTRIFUGAL HVAC FANS

PART 1 - GENERAL
submittal requirements
Product Data
1. Provide for each type of product indicated.
Shop Drawings
2. Coordination drawings
   a. Include plans, elevations, sections, and attachment details.
   b. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   c. Include diagrams for power, signal, and control wiring.
3. Design Calculations
   a. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
4. Vibration Isolation Base Details
   a. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

PART 2 - PRODUCTS
general
Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Acme Engineering & Mfg. Corp.
2. Greenheck Fan Corporation.
3. Loren Cook Company.
4. Twin City Fan Companies.
Project Altitude: Base fan-performance ratings on actual Project site elevations.
Operating Limits: Classify according to AMCA 99.
Prelubricated and Sealed Shaft Bearings:
5. Self-aligning, pillow-block-type bearings.
6. Ball-Bearing Rating Life: ABMA 9, Ll0 at 80,000 hours.
7. Roller-Bearing Rating Life: ABMA 11, Ll0 at 80,000 hours.
Grease-Lubricated Shaft Bearings:
8. Self-aligning, pillow-block-type, tapered roller bearings with double-locking collars and two-piece, cast-iron housing.
9. Ball-Bearing Rating Life: ABMA 9, Ll0 at 80,000 hours.
10. Roller-Bearing Rating Life: ABMA 11, Ll0 at 80,000 hours.
UTILITY SET FANS
Housing: Fabricated of steel with side sheets fastened with a deep lock seam or welded to scroll sheets.
11. Housing Discharge Arrangement: Adjustable to eight standard positions.
Fan Wheels: Single-width, single inlet; welded to cast-iron or cast-steel hub and spun-steel inlet cone, with hub keyed to shaft.
12. Blade Materials: Steel.
13. Blade Type: Backward inclined.
Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
Accessories:
14. Inlet and Outlet: Flanged.
15. Companion Flanges: Rolled flanges for duct connections of same material as housing.
16. Access Door: Gasketed door in scroll with latch-type handles.
17. Inlet Screens: Removable wire mesh.
18. Drain Connections: NPS 3/4 threaded coupling drain connection installed at lowest point of housing.
19. Weather Hoods: Weather resistant with stamped vents over motor and drive compartment.
MOTORS
Motors with Variable frequency drives: All fan motors shall be of the highest efficiency possible, either Premium or High Efficiency rating. All fan motors with VFD's must be inverter duty rated and AHU manufacturer shall factory inverter balance the fan motor through the entire operating range. A/C motors shall be rated for both constant and variable speed applications.

PART 3 - EXECUTION
INSTALLATION
Fan(s) shall be installed a minimum of 10'-0" from any roof edge regardless of location indicated on plans, unless a screen wall or railing is installed per the local building code. See the architectural plans for coordination.
Provide high static pressure switch in the ductwork downstream of exhaust fans greater than 3 hp. Fan shall shutdown upon detection of static pressure in excess of 2" wc.. Provide manual reset.
Curb Support: Install insulated, manufacturer's insulated roof curb on roof structure, level and secure, according to "The NRCA Roofing and Waterproofing Manual," Low-Slope Membrane Roofing Construction Details Section, Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install and secure centrifugal fans on curbs, and coordinate roof penetrations and flashing with roof construction. Secure units to curb support with anchor bolts.

End of Section 233416.00

23 37 13.00 – DIFFUSERS, REGISTERS AND LOUVERS

Submittal Requirements
Product Data: For each type of product indicated.

DIFFUSERS, GRILLES AND REGISTERS
Manufacturer: Subject to compliance with requirements, provide diffusers of one of the following:
Anemostat Products Div., Dynamics Corp. of America.
Metal-Aire
Titus Products Div., Philips Industries, Inc.
Tuttle and Bailey.
Price

SECTION 237223.00 - PACKAGED AIR TO AIR ENERGY RECOVERY UNITS

PART 4 - GENERAL
submittal requirements
Product Data
1. Provide for each type of product indicated.
   a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for units.
   b. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
Shop Drawings
2. Coordination Drawings.
   a. Include plans, elevations, sections, and mounting details.
   b. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   c. Detail fabrication and assembly of equipment.
   d. Include diagrams for power, signal, and control wiring.
Warranty
Manufacturer's Warranty
3. All units have a one-year parts and labor warranty of one year from start-up or 18 months from shipment, whichever occurs first.
4. A standard factory five-year compressor warranty shall be provided. The warranty shall be a parts only warranty, effective for 5 years from shipment.

PART 5 - PRODUCTS
MANUFACTURER
Subject to compliance with requirements, provide products from one of the following manufacturers:
1. Addison
2. Climate Pak
3. Daikin
4. Innovent
5. Valent
6. Mammoth
7. Venmar
8. Aaon
9. Trane
10. Johnson Controls
11. Greenheck
12. Semco
13. Loren Cook Company
14. Ruskin Company
15. Xetec
16. Reznor
17. Mitsubishi Electric

2.2. MANUFACTURED UNITS
A. Unit shall be fully assembled at the factory and consist of an insulated metal cabinet, downturn outdoor air intake with 2" aluminum mesh filter assembly, exhaust air blower, energy core, hot gas reheat coil, air-source heat pump, phase and brownout protection, motorized dampers, curb assembly, filter assembly intake air, supply air blower assembly, exhaust/relief blower assembly, filter assembly for exhaust air, and an electrical control center. All specified components and internal accessories factory installed are tested and prepared for single-point high voltage connection except with electric post heat and exhaust fan only power which have dual point power.

2.3. CABINET
A. Materials: Formed, double wall insulated metal cabinet, fabricated to permit access to internal components for maintenance.
   1. Internal assemblies: 24 gauge, galvanized (G90) steel except for motor supports which shall be minimum 14 gauge galvanized (G90) steel.
B. Cabinet Insulation: Comply with NFPA 90A and NFPA 90B and erosion requirements of UL 181.
   1. Materials: Rigid urethane injected foam. Foam board not acceptable.
      a. Thickness: 2 inch (50.8 mm)
      b. Thermal Resistance R13
      c. Thermally broken
      d. Meets UL94HF-1 flame requirements.
      e. Location and application: Full coverage of entire cabinet exterior to include walls, roof of unit, unit base, and doors.
   2. Materials: Fiberglass insulation. If insulation other than fiberglass is used, it must also meet the Fire Hazard Classification shown below.
      a. Thickness: 2 inch (50.8 mm)
      b. Thermal Resistance R8
      c. Fire Hazard Classification: Maximum flame spread of 25 and smoke developed of 50, when tested in accordance with ASTM C 411.
      d. Location and application: Divider panels between outdoor air and return air/exhaust air streams.
C. Roof Insulation: 2 inch (50.8 mm) fiberglass located above the 1 inch (25.4 mm) foam panel.
D. Access panels / doors: Unit shall be equipped with insulated, hinged doors or removable access panels to provide easy access to all major components. Doors and access panels shall be fabricated of 18 gauge galvanized G90 steel or painted galvannealed steel.
E. Supply Air blower assemblies: Blower assembly shall consist of an electric motor and direct-drive fans. Assembly shall be mounted on heavy gauge galvanized steel rails and further mounted on 1.125 inch thick neoprene vibration isolators. Blower motors shall be capable of continuous speed modulation and controlled by a VFD.
F. Exhaust Air blower assemblies: Blower assembly shall consist of an electric motor and a direct-drive fan. Assembly shall be mounted on heavy gauge galvanized steel rails and further mounted on 1.125 inch thick neoprene vibration isolators. Blower motor shall be capable of continuous speed modulation and controlled by a VFD.
G. Control panel / connections: Units shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections. RTU shall be equipped with a Unit Disconnect Switch. Electric heater shall have single point power.
H. Condensate drain pan: Drain Pan shall be an integral part of the unit whenever a cooling option is included. Pan shall be formed of welded austenitic stainless steel sheet material and provided with a welded stainless steel drain connection at the front for connection to a P trap. Drain pan shall be sloped in two directions to provide positive draining and drain connector shall be sealed at penetration through cabinet wall.
I. P trap: If the unit is equipped with a condensate drain pan, contractor shall provide, or fabricate, and install an appropriate P trap, in accordance with all local and area codes and Best Practices.
J. Energy core: Air-to-air heat exchanger shall provide sensible and latent energy transfer in a crossflow arrangement. Heat exchanger shall be constructed of media coated with hydrophilic resin housed within a G90 galvanized frame. Heat exchanger shall have no moving parts, motors, belts, or pulleys. The material shall not promote mold or bacteria growth and must have successfully passed ASTM-G21 testing. A bypass damper shall be provided for frost control purposes.
K. Core Frost Control: Core Bypass: A bypass damper shall be provided for frost control of the energy core. Control system shall include an exhaust air temperature sensor.
L. Reheat coil with factory installed modulating hot gas reheat valve.
M. Electric Post-heater: Post-heater shall be SCR control and shall include a temperature sensor with field adjustable set point, located in the outdoor air stream. Heat output of the post-heater shall be infinitely variable. Electric post-heater shall be able to simultaneously operate with the air-source heat pump.
N. Condenser Fans: Fan blades must be constructed of aluminum or a composite material and have a geometry designed and documented to reduce sound and energy when compared to a traditional rectangular blade fan. Traditional rectangular blade fans are not allowed due to increased noise generated and increase power utilized. Condenser fan motors shall be three phase, external rotor, type 56 frame, open air over and shaft up. Each condenser fan motor shall have a vented frame, rated for continuous duty and be equipped with an automatic reset thermal protector. Lead condenser fan(s) will have an electronically commutated (EC) motor that will modulate to maintain a head pressure set point.] Motors shall be UL Recognized and CSA Certified. Single condenser fan running at max RPM and design static pressure shall not exceed an A-weighted sound power level of 75 db at free inlet/outlet test conditions.
O. Phase and brownout protection: Unit shall have a factory-installed phase monitor to detect electric supply phase loss and voltage brown-out conditions. Upon detection of a fault, the monitor shall disconnect supply voltage to all motors.
P. Motorized dampers / Intake Air, Motorized dampers of low leakage type shall be factory installed.
Q. Curb Assembly: A curb assembly made of 14 gauge galvanized steel shall be provided by the factory for assembly and installation as part of this division. The curb assembly shall provide perimeter support of the entire unit and shall have duct adapter(s) for supply air and return air. Curb assembly shall enclose the underside of the unit and shall be sized to fit into a recess in the bottom of the unit. Contractor shall be responsible for coordinating with roofing contractor to ensure curb unit is properly flashed to provide protection against weather/moisture penetration. Contractor shall provide and install appropriate insulation for the curb assembly. The curb shall be the height of 14 in.
R. Service receptacle: 120 VAC GFCI service outlet shall be factory-provided and installed by this contractor in a location designated by the A / E. Service outlet requires a dedicated single phase electric circuit. Unit contains a 120 VAC transformer to provide power to service outlet.

2.4. BLOWER
A. Blower section construction, Supply Air: direct drive motor and blower shall be assembled on a 14 gauge galvanized steel platform and shall be equipped with 1.125 inch thick neoprene vibration isolation devices.
B. Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.
C. Fan: Direct drive, airfoil plenum fan with aluminum wheel statically and dynamically balanced. Prop or belt-drive fan not acceptable due to low static capabilities.
D. Blades: Welded aluminum blades only.
E. Blower section motor source quality control: Blower performance shall be factory tested for flow rate, pressure, power, air density, rotation speed and efficiency. Ratings are to be established in accordance with AMCA 210, "Laboratory Methods of Testing Fans for Rating".

2.5. MOTORS
A. General: Blower motors greater than 1/2 horsepower shall be "NEMA Premium" unless otherwise indicated. Compliance with EPAct minimum energy-efficiency standards for single speed ODP and TE enclosures is not acceptable. Motors shall be heavy-duty, permanently lubricated type to match the fan load and furnished at the specified voltage, phase and enclosure.
B. Motors shall be 60 cycle, 3 phase 460 volts.

2.6. UNIT CONTROLS
A. The unit shall be constructed so that it can function as a stand-alone heating and cooling system controlled by factory-supplied controllers, thermostats and sensors or it can be operated as a heating and cooling system controlled by a Building Management System (BMS). This unit shall be controlled by a factory-installed microprocessor programmable controller (DDC) that is connected to various optional sensors.
B. Unit shall incorporate a DDC controller with integral LCD screen that provides text readouts of status. DDC controller shall have a built-in keypad to permit operator to access read-out screens without the use of ancillary equipment, devices or software. DDC controllers that require the use of equipment or software that is not factory-installed in the unit are not acceptable. Alarm readouts consisting of flashing light codes are not acceptable. Owner-specified ventilating conditions can be input by means of pushbuttons.
C. Unit supply fan shall be configured for Constant Volume (ON/OFF).
D. Unit exhaust fan shall be configured for Constant Volume (ON/OFF).
E. Outside Air / Return Air damper control shall be
F. Economizer control shall be temperature / enthalpy.
G. Dirty filter sensor shall be factory installed.
H. Operating protocol: The DDC shall be factory-programmed for BACNetMSTP.
I. Variable Frequency Drive (VFD): unit shall have factory installed variable frequency drive for modulation of the supply and exhaust air blower assemblies. The VFD shall be factory-programmed for unit-specific requirements and shall not require additional field programming to operate.
J. Airflow monitoring required in the supply, and exhaust airstreams.
K. Secondary heating source shall be capable of simultaneous operation with the air-source heat pump.

2.7. FILTERS
A. Unit shall have permanent 2 inch (50.8 mm) aluminum filters located in the outdoor air intake and shall be accessible from the exterior of the unit. MERV 8 disposable pleated filters shall be provided in the supply air stream. MERV 8 disposable pleated filters shall be provided in the supply final air stream and MERV 8 filters in the exhaust air stream.

PART 3 - EXECUTION
3.1. EXAMINATION
A. Prior to start of installation, examine area and conditions to verify correct location for compliance with installation tolerances and other conditions affecting unit performance. See unit IOM.
B. Examine roughing-in of plumbing, electrical and HVAC services to verify actual location and compliance with unit requirements. See unit IOM.
C. Proceed with installation only after all unsatisfactory conditions have been corrected.

3.2. INSTALLATION
A. Installation shall be accomplished in accordance with these written specifications, project drawings, manufacturer's installation instructions as documented in manufacturer's IOM, Best Practices and all applicable building codes.

3.3. CONNECTIONS
A. In all cases, industry Best Practices shall be incorporated. Connections are to be made subject to the installation requirements shown above.
B. Piping installation requirements are specified in Division 22 (Plumbing). Drawings indicate general arrangement of piping, fittings and specialties.
C. Duct installation and connection requirements are specified in Division 23 of this document.
D. Electrical installation requirements are specified in Division 26 of this document.

3.4. FIELD QUALITY CONTROL
A. Manufacturer's Field Service: Engage a factory authorized service representative to inspect field assembled components and equipment installation, to include electrical and piping connections. Report results to A / E in writing. Inspection must include a complete startup checklist to include (as a minimum) the following: Completed Start-Up Checklists as found in manufacturer's IOM.

3.5. START-UP SERVICE
A. Engage a factory authorized service representative to perform startup service. Clean entire unit, comb coil fins as necessary, install clean filters. Measure and record electrical values for voltage and amperage. Refer to Division 23 "Testing, Adjusting and Balancing" and comply with provisions therein.

3.6. DEMONSTRATION AND TRAINING
A. Engage a factory authorized service representative to train owner's maintenance personnel to adjust, operate and maintain the entire unit. Refer to Division 01 Section Closeout Procedures and Demonstration and Training.

PART 6 - EXECUTION
INSTALLATION OF HEAT RECOVERY SYSTEM:
The heat recovery unit(s) shall be installed a minimum of 10'-0" from any roof edge regardless of location indicated on plans, unless a screen wall or railing is installed per the local building code. See the architectural plans for coordination.

End of Section 237223.00

THIS SHEET WHEN PLOTTED AT FULL SIZE MEASURES 30" X 42"

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ARCX STUDIO PROJECT NUMBER
2325

OWNER

STATE OF OHIO
KRIS T. SCHNITGEN
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REGISTERED PROFESSIONAL ENGINEER
1/19/2024

REVISION

Δ	DESCRIPTION	DATE

ISSUED FOR
BID & PERMIT
01-19-2024

SHEET NAME
MECHANICAL - SPECIFICATIONS

SHEET NO.
M9.71